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(B. DUNSTAN, CHIEF GOVERNMENT GEOLOGIST.)

PUBLICATION No. 263.

Mesozoic Floras of Queensland.

Parts III. and IV.

The Floras of the Burrum and Styx River Series.

BY

A. B. WALKOM, D.Sc.,
Assistant Lecturer in Geology, The University of Queensland.

WITH 7 PLATES

AND

A GEOLOGICAL NOTE AND SECTIONS

(WITH 1 PLATE AND 2 TEXT FIGURES),

BY

B. DUNSTAN,
Chief Government Geologist.

BRISBANE:
BY AUTHORITY: ANTHONY JAMES CUMMING, GOVERNMENT PRINTER.

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GEOLOGICAL NOTE ON THE BURRUM AND STYX COAL MEASURES.

By B. Dunstan.

The palæontological bulletin by Dr. Walkom herewith presented contains a description of the fossil plants of the Lower Cretaceous Beds occurring in the Burrum and Styx Coal Measures, the work forming another very worthy addition to the series of articles by the same author commenced some time ago on the Mesozoic Floras of Queensland.

The investigation has resulted in several new species being revealed, which in itself is both satisfactory and useful, but it will be of service, more particularly, in field operations, as it is now shown that the portions of the coal measures which contain the workable coal-seams do not appear to be so congenial to the preservation of the flora as the non-productive measures resting on them, a fact of some importance in working out and mapping the undeveloped portions of the coalfield. To students, it may also be stated, the subject will now become more attractive, as the whole of the flora has been systematized and, where necessary, illustrated.

The Burrum Coal Measures extend along the eastern coast line of the State from Baffle Creek, near Rosedale, on the North Coast Line, down to Maryborough, a distance of about 100 miles. For many years past this field has received the attention of geologists on account of its valuable coal-seams, which have been worked to some extent at Howard, Burrum River, and Torbanlea. Prior to the last examination there were several diverse opinions as to the age of the coal-bearing rocks and their relation to the marine beds associated with them, but the stratigraphical features have now been definitely outlined while the question of age has been satis factorily settled as a result of the present palæontological work.

Many other localities are known where the measures are productive, as at Takura and several places on the Isis and Gregory Rivers, while boring and shaft-sinking operations have revealed their presence where previously they had not been identified but where geological surveys had indicated probabilities of their occurrence.

Between Maryborough and Baffle Creek, the coal measures in part are covered with basalt flows, but the trend of numerous coal-bearing belts of country is being gradually defined, and sooner or later there should be discovered in the country to the west of Bundaberg seams of workable thickness similar in quality to those being worked about the Burrum River. This is made apparent by the general resemblance of the geological features in the two areas and also from the palæontological evidence which has been brought to bear on the subject.

The whole of the Burrum Coal Measures has not been examined for fossil remains—the searching mostly being carried on in localities where coal mining or prospecting operations are in progress—so that the forms described may be augmented by further searching. Some of the specimens are from coal workings, some from natural outcrops, but most of them are from coal-prospecting bores. Cores have been examined from bores at Urangan, Takura, Aldershot, Argyle Creek, Torbanlea, and Burrum River (Riverbank and Dundee), and nearly all have yielded specimens of fossil plants.

The geological features of the Burrum Coal Area have already been outlined in a prefatory note on the preceding Part (II.) of the Mesozoic Floras of Queensland,[1] wherein is also given a general geological cross-section of the strata and a map showing the boundaries of the coal measures and the associated (?) Lower Cretaceous marine beds. A portion of this map is here reproduced as a text figure, with additions to show the positions of the groups of prospecting bores and other localities where the plant remains have been obtained.

The Takura coal-bores, numbered respectively from 1 to 5, were sunk close to the Colton-Pialba railway line at positions between three and six miles from the former station, while three

[1] Q.G.S. Publication No. 262.

GEOLOGICAL SECTIONS in MARYBOROUGH DISTRICT

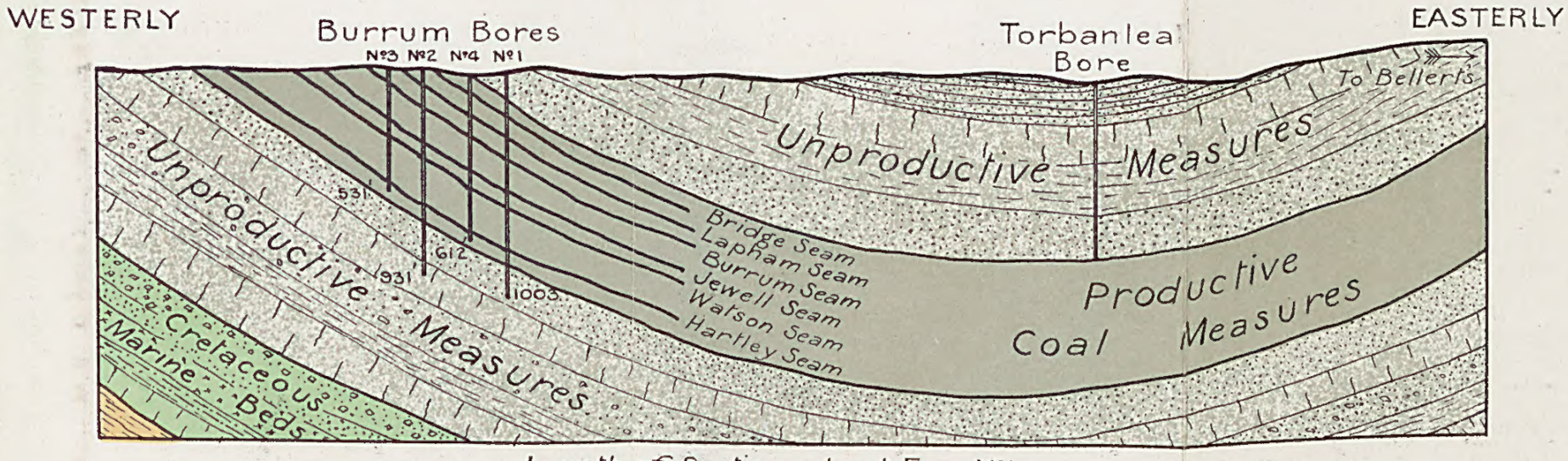
by

B. DUNSTAN.

Accompanying "Mesozoic Flora of Queensland," Part 3.
See General Section in Mesozoic Flora, Part 2, Pub^n No 262.

(A) BURRUM DIAGRAMMATIC SECTION

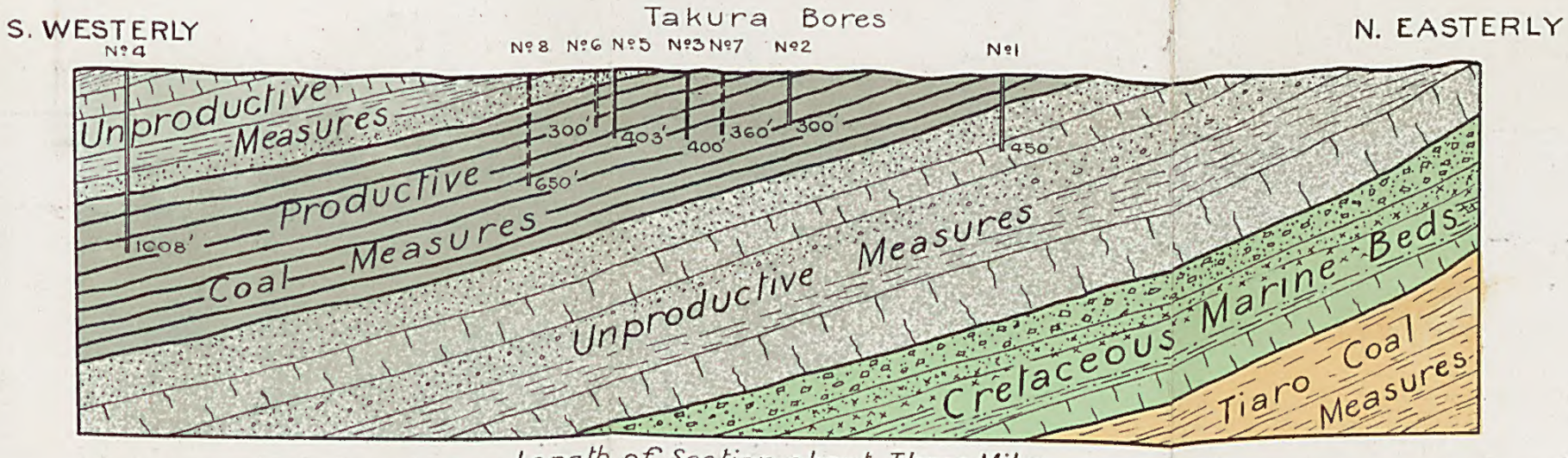
Burrum Coalfield



Length of Section about Four Miles.

(B) TAKURA DIAGRAMMATIC SECTION

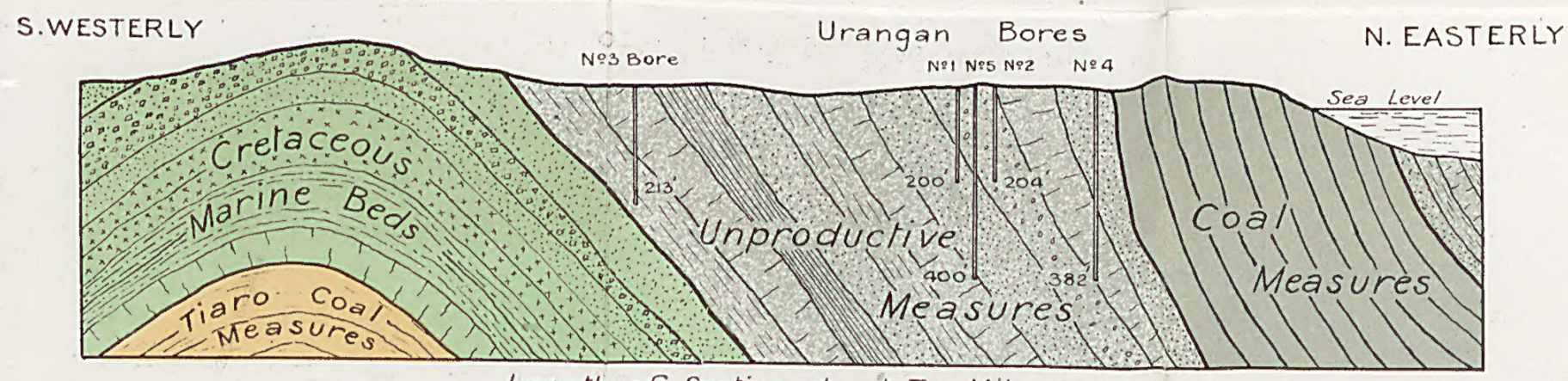
Colton–Pialba Railway Line.



Length of Section about Three Miles.

(C) URANGAN DIAGRAMMATIC SECTION

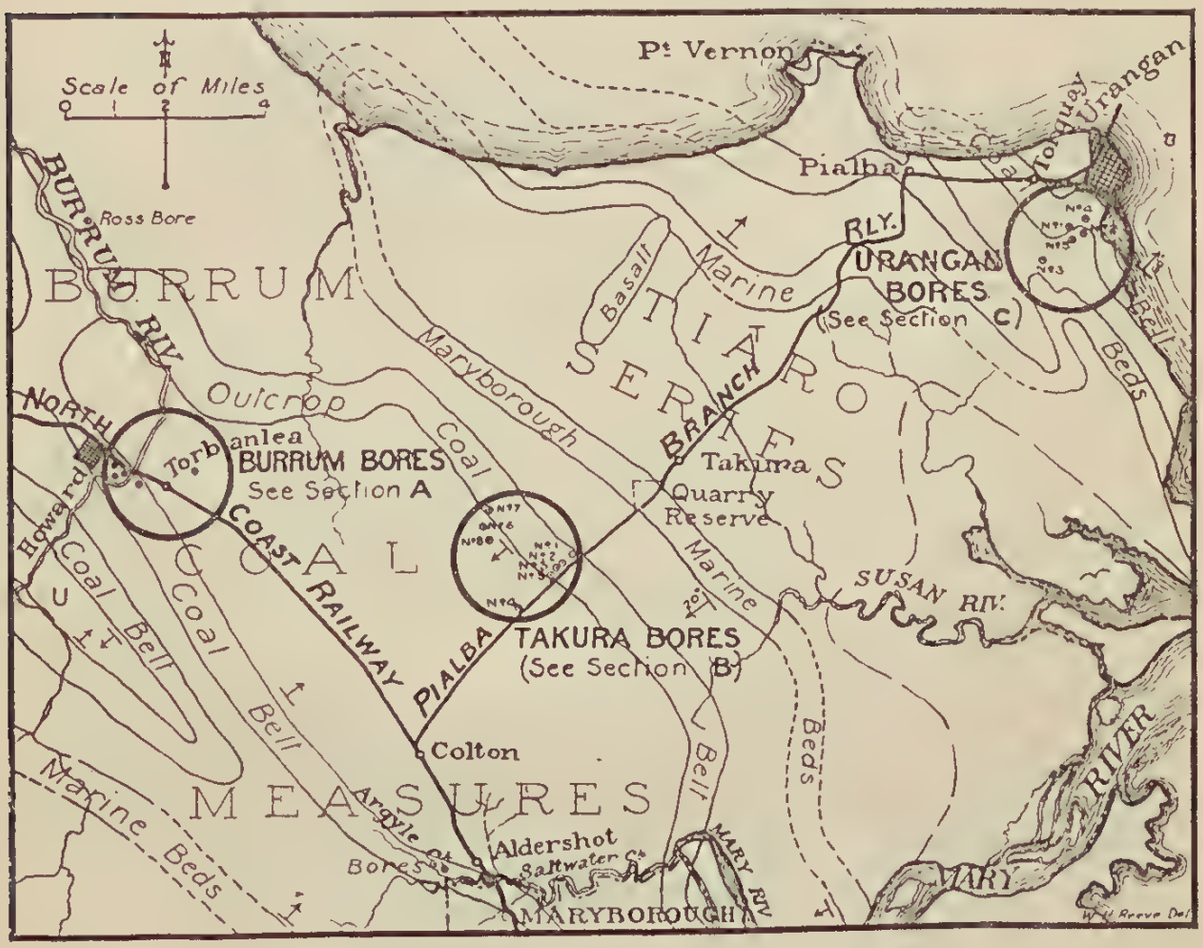
South of Urangan Railway Line.



Length of Section about Two Miles.

W.H. Reeve Del.

other bores, numbered 6 to 8, are situated about two miles from the railway line in a north-westerly direction from the four-mile peg. The Takura diagrammatic vertical section, given on Plate A, is taken across the strike of the marine beds and coal measures in the vicinity of the railway line, and indicates the position of the bores and the strata they have passed through. All the bores with the exception of No. 4 are in what is called the productive coal belt, the excepted bore being in the non-productive zone. The productive belt is much less prolific in plant remains than the unproductive belt above, the latter containing both a greater number and variety of fossil forms than the portion of the coal measures where the seams are being worked.



The Urangan bores, numbered from 1 to 5, are located to the south of the Urangan railway station and between two and three miles distant. Plate A shows a vertical section indicating the position of the bores with regard to the non-productive strata

and to the coal measures which they were supposed to test. There was no justification, it may be stated, for sinking any of these bores as the beds to the north-east are very strongly inclined, and the working of a coal-seam, if found, would certainly be very difficult and costly. One of the bores was sunk far away from the coal measures, and the lower portion of the bore appeared to be in the upper portion of the marine strata and more than a thousand feet below the horizon of the coal-seams.

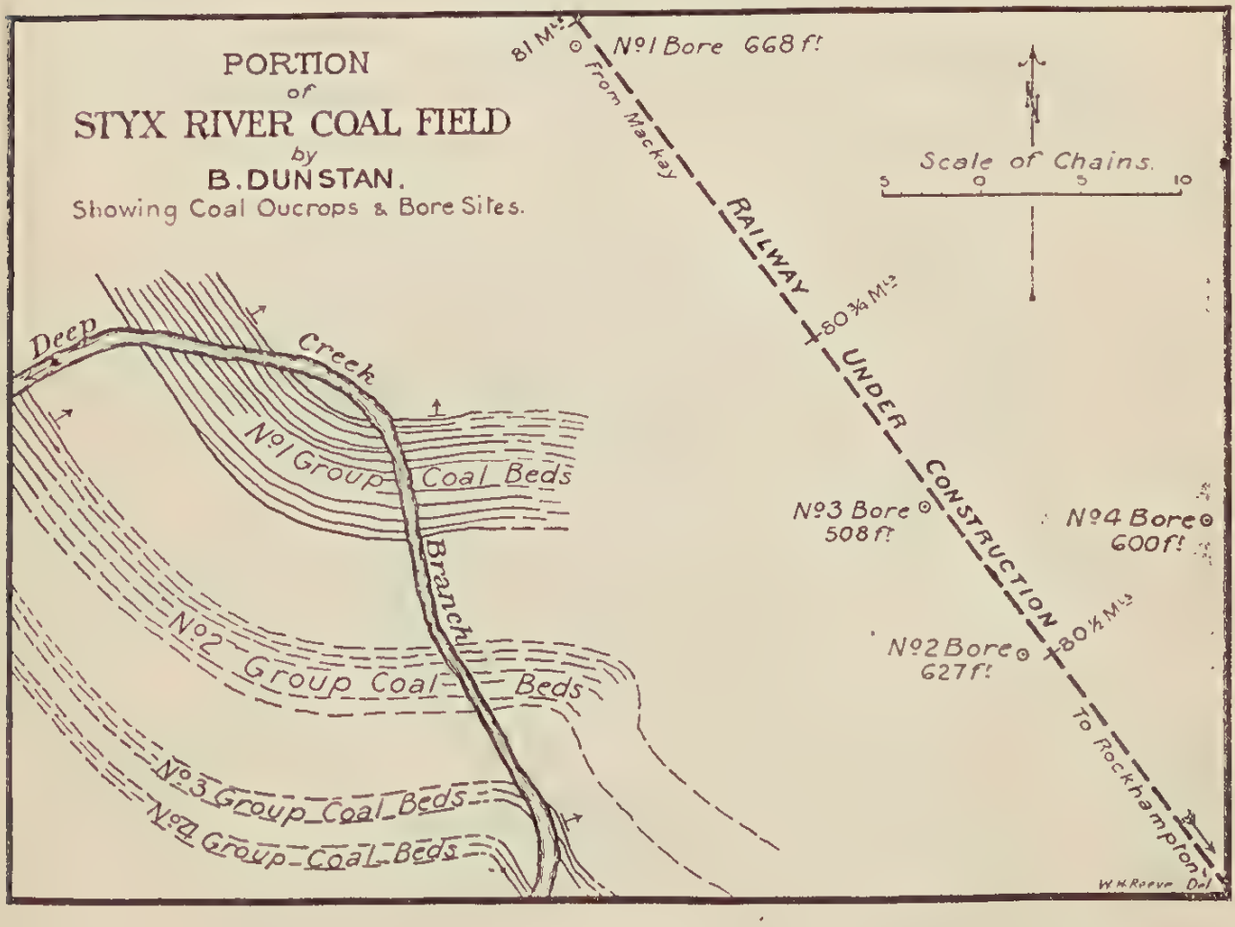
At Argyle Creek two bores were sunk, the first one being situated about two miles west of Aldershot railway station close to the junction of Argyle and Saltwater Creeks, the second bore about half a mile E.S.E. of No. 1. The stratigraphical information available indicates the position of the strata to be well within the productive belt of coal measures, and the paucity of fossils in the cores and rock outcrops rather bears this out.

The first Burrum bore was sunk on the Riverbank area on the eastern side of the river, the other bores being put down on the Dundee area further west on the opposite side of the river. All the bores are closely associated with the productive coal-belt and have yielded only a few fossil remains. The section across this area, Plate A, diagrammatically illustrates the lines of stratification about Howard, Burrum River, and Torbanlea. It also shows that the bore at Torbanlea, which is to the east of the railway station, has not touched the productive coal-belt below, while it also shows that some of the bores on the Burrum have passed down through this belt into the unproductive strata.

Other positions on the Burrum Coalfield where fossils have been found include Dundee (Dudley), Clyde, Bellert's, and Riverbank Collieries, Turner's Selection on the Burrum River, and Briton's Shaft near Howard.

The thickness of the coal-bearing belt is estimated to be 1,000 feet, within which there is a varying thickness of between 500 and 700 feet of strata containing coal-seams of good workable size. About 2,000 feet of unproductive measures (*i.e.*, strata containing bands and very small useless seams of coal) also exist both above and below this belt, making a total thickness of 5,000 feet of sediments above the (?) Lower Cretaceous Marine Beds.

The Styx Coalfield is situated close to St. Lawrence on the eastern coast and roughly is about halfway between Rockhampton and Mackay. It is crossed by the coastal railway line now under construction between these three ports of which the section from Rockhampton to the Styx River is almost completed, and is therefore an important area in which to find productive coal measures.



With the object of testing the localities where coal-seams have been exposed and which have been known for some years past a number of bores have been sunk, the results showing that the measures are extremely irregular, and the seams with few exceptions too small to work, although containing coal of excellent quality. Shaft-sinking operations have been started to open up the most promising seam the bores revealed, and in sinking the shaft no doubt more detailed information will be forthcoming concerning the strata and their fossil contents.

Deep Creek at the head of the Styx River contains a number of rock and coal outcrops along its banks and bed, the exposures

showing that the measures are made up of a great number of beds of friable tuffaceous sandstones alternating with bluish and buff-coloured shales and containing about twenty seams of bright bituminous coal. There are other positions on the coalfield where coal is known to occur, but most of the country is difficult to prospect on account of the superficial covering of alluvial deposits and because of the dense scrub which in places cover it.

The four coal-bores sunk are close to the railway route between the 80½-mile and 81-mile pegs, their positions being shown on the accompanying sketch-plan.

THE FLORA OF THE BURRUM SERIES.

By A. B. Walkom, D.Sc.

AGE AND RELATIONS OF THE BURRUM FLORA.

Very little work has hitherto been carried out in connection with the flora of this Series.

Tenison-Woods, in his work on the Fossil Flora of the Coal Deposits of Australia, in 1883, described four species from this Series, viz. :—*Sphenopteris flabellifolia*, *Sphenopteris flabellifolia* var. *erecta*, *Jeanpaulia bidens*, and *Araucarites* (?) *polycarpa*.

In 1892, in the Geology and Palæontology of Queensland, ten species of plants were described from the Burrum Series, but only nine of these actually came from this Series, the tenth coming from the Styx River Coal Measures. The species described from the Burrum Series were—

Sphenopteris flabellifolia,
Sphenopteris flabellifolia, var. *erecta*,.
Trichomanites laxum,
Thinnfeldia media (?),
Alethopteris australis,
Podozamites Kidstoni,
Podozamites sp.,
Otozamites (?) sp.,
Baiera bidens.

At that time the Burrum Series was regarded as Lower Trias-Jura in age. These are the only descriptions of the fossil plants from the Burrum Series.

In a recent paper [2] on the Lower Mesozoic Rocks of Queensland I have given a short account of the various interpretations of the stratigraphical position of the Burrum Series.

---

[2] Walkom (18a), p. 45.

The flora of the Burrum Series is a typical Lower Cretaceous flora, undoubtedly homotaxial with such floras as the Wealden of Europe and the Lower Cretaceous (Neocomian) of North America etc., and, as now known, it comprises some 36 species as follows :

? *Neocalamites* sp.,
Cladophlebis australis,
? *Thinnfeldia lancifolia*,
? *Dictyophyllum* sp.,
Sphenopteris flabellifolia,
Sphenopteris erecta,
Sphenopteris burrumensis,
? *Chiropteris* sp.,
Phyllopteris lanceolata,
Phyllopteris expansa,
Microphyllopteris gleichenioides,
Microphyllopteris acuta,
Stenopteris elongata,
Stenopteris laxum,
Ptilophyllum (*Williamsonia*) *pecten*.
Zamites takuraensis,
Nilssonia schaumburgensis,
Nilssonia mucronatum,
Otozamites sp.,
Tæniopteris spatulata,
Tæniopteris howardensis,
Tæniopteris sp.,
Ginkgo digitata,
Baiera bidens,
Araucarites polycarpa,
Araucarites Arberi,
Brachyphyllum crassum,
Elatocladus planus,
? *Elatocladus* sp.,
Nageiopsis zamioides,
Pagiophyllum Jemmetti,
Pagiophyllum peregrinum (?)
? *Sphenolepidium* sp.,
Podozamites Kidstoni,
Podozamites lanceolatus,
Podozamites sp.,
? Equisetaceous sheath,
? Obscure cones,
? Roots.

An analysis of this flora shows that at least about twelve of the species described can be compared fairly closely with Lower Cretaceous species. In making such comparison there is considerable difficulty when the literature available is somewhat limited, and it is therefore not improbable that more of the Queensland specimens show affinities with Cretaceous species.

If, instead of a comparison of individual species, the representation of the major plant groups in the flora is considered, a more reliable basis for general correlation is obtained.

The Burrum Flora is distributed over the larger plant groups thus :—

Equisetales	1 (?) species
Filicales, &c.	13 species
? Cycadophyta (Tæniopteris)	3 „
Cycadophyta	5 „
? Coniferales (Podozamites)	3 „
Coniferales	9 „
Ginkgoales	2 „
Total	36 species

A comparison of the flora of the Burrum Series with those of Jurassic and Cretaceous age shows that it undoubtedly has a Lower Cretaceous facies. Such a comparison is made easy by Berry's account of the Lower Cretaceous floras of Virginia and Maryland, in which he has summarised and discussed the Lower Cretaceous floras known from different parts of the world.

In his work on this subject Berry adopts De Lapparent's nomenclature of the subdivisions of the Lower Cretaceous, in which four stages are recognised, viz., Neocomian, Barremian, Aptian, and Albian in ascending order. The term "Wealden" has been very largely used in connection with the Lower Cretaceous, particularly when fossil plants are under discussion. We may therefore quote Berry's remarks on this term. He says : "The discussions of the age of the Wealden rival in volume those of the Rhætic, Hercynian, and Laramie questions. As transitional deposits the Wealden may well be partly of Jurassic age, but of late years it has come to be accepted as a non-marine facies of the Neocomian, since, where it is present, the lowest marine beds of the Neocomian are said to be absent."[3]

[3] Berry (11), p. 101.

For the purposes of comparison the following table, showing the percentages in a number of important Lower Cretaceous floras, has been compiled mainly from Berry's account :—

—	Burrum Series.	Portugal, Lower Cretaceous.	England, Wealden.	Germany, Wealden.	S. Africa, Uitenhage.	Koctanie.	Upper Knoxville.	POTOMAC.			Japan Wealden.
								Patuxent.	Arundel.	Patapsco.	
	%	%	%	%	%	%	%	%	%	%	%
Equisetales.. ..	3	1	4	3	5	2	3	2	..	3	..
Filicales, &c. ..	44	51	33	54	33	40	42	42	32	33	43
Cycadophyta ..	22	10	34	18	38	22	42	22	21	14	47
Coniferales	25	23	23	21	24	29	12	26	34	7	7
Ginkgoales	6	..	..	3	..	7	..	1	..	..	..
Angiosperms ..	..	15	..	..	..	..	..	..	..	36	..
No. of species present	36	88	70	33	21	86	33	88	38	69	28

This table has been drawn up so as to conform with such tables as those prepared by Wieland,[4] and it must once more be pointed out that care is needed in their interpretation. Although there is evidence that we may have to transfer Tæniopteris to the Cycads, and perhaps Podozamites to the Conifers, this has not been done in the table. When the positions of a number of such genera are finally settled, all numerical tables of this nature will need revision, but for the present their value for comparative purposes makes their compilation worth while.

Wieland has made a comparison of a number of Lower Cretaceous floras and has noted that they are generally consistent in their broader outlines. The characteristic features of the floras of this age, as described by Wieland, are as follows :—

1. "*Cordaites*, which still held a fast lessening place in the early Jura leaves behind only a few lingering hypothetical forms like Eolirion."

2. "The Equisetums left over in the Jura-Rhætic groups are now positively reduced to present day scant numbers."

[4] Wieland (13).

3. "The high frequency of ferns represents the culmination of the mid-Mesozoic fern recrudescence due to the spread of the more strictly modern types."
4. "The persistent presence of conifers in numbers at first sharply increasing and then followed by decline in both the percentage and actual number of species recovered, is in striking contrast to the moderate numbers of the Lower Jura. It may, in fact, be definitely accepted that, taking the world over, a strong fifth of Lower Cretaceous vegetation was coniferous. This is the proportion in the English Wealden, in the Potomac, and apparently in all the horizons where collecting has been most thorough."
5. "The cycadophytan and coniferous elements quite exactly balance each other, the time when these gymnospermous types are to reverse their Jurassic proportions being near at hand.[5]

He gives the normal percentages in Lower Cretaceous floras as ferns 45, cycads 20, and conifers 25. Examination of the table above, and the application of the remarks just quoted to the Burrum Flora, show that it is a typical Lower Cretaceous (Neocomian-Barremian or Wealden) flora, most closely comparable with the American Kootanie and Patuxent floras and the German Wealden flora.

The flora of the Burrum Series is quite distinct, as a whole, from those of the earlier Mesozoic strata of Queensland. The most notable difference is in the proportion of Conifers, which are much more abundant in the Burrum Series. Only nine of the 36 Burrum species occur in the Walloon Series. The differences as a whole can be seen from the following table :—

—	Ipswich Series.	Walloon Series.	Maryborough Series.	Burrum Series.
	%	%	%	%
Equisetales	15	8	7	3
Filicales, &c. (including Tæniopteris)	66	53	29	44
Cycadophyta	6	25	14	22
Coniferales	..	8	36	25
Ginkgoales	21	6	14	6
Number of species	33	36	14	36

The percentages in this table for the Maryborough Series are of much less value than those for the other series, on account of the small number of species in the Maryborough flora.

[5] Wieland (13), p. 274.

BEARING OF BURRUM FLORA ON THE STRATIGRAPHICAL HORIZON OF THE ROLLING DOWNS SERIES, &c.

The determination of the Burrum Flora as Lower Cretaceous raises some interesting questions regarding the position of the Queensland Cretaceous rocks in the Geological Record. These rocks consist of a lower series of marine sediments and an upper series of freshwater deposits, the former being previously regarded as Lower Cretaceous and the latter Upper Cretaceous.

There has even been a tendency by some authors to regard the Rolling Downs Series as Upper Cretaceous, chiefly on the ground that the Upper Cretaceous was a period of world-wide marine transgression, the Rolling Downs marine deposits being regarded as part of the result of this transgression.[6]

The flora shows the Burrum Series to be Lower Cretaceous, homotaxial with the lowest divisions, viz., Neocomian-Barremian, and this will necessitate some revision of our interpretation of the so-called Cretaceous marine Series. It certainly looks as if the Rolling Downs Series may have to be regarded as Upper Jurassic, but the only way this can be determined is by a careful and critical revision of the fauna of this Series. It may be noted that in the last extensive examination of the fauna of the Rolling Downs Series, in 1892, Mr. R. Etheridge Jr. remarks that he had "for some time past advocated classing the Rolling Downs Beds under the general term Cretaceous, admitting, however, at the same time that they contain an admixture of Oolitic as well as Cretaceous life."[7] This is, as far as I know, the last definite pronouncement as to the age of the fauna of the Rolling Downs Series, and it expresses a doubt as to whether the fauna is rightly placed in the Cretaceous.

One other possibility suggests itself. The Rolling Downs Series in Western Queensland is generally regarded as the equivalent of the Maryborough Marine Series in Eastern Queensland. The faunas of these two Series show a general similarity, but as the greater part of the fauna of the Maryborough Series is still undescribed, there is the possibility of these two Series representing different horizons.

These stratigraphical questions can only be answered when the marine fauna of the Maryborough Series is completely described and that of the Rolling Downs Series examined in the light of the deductions made above from the examination of the Burrum Flora.

---

[6] Andrews (16), p. 762.
[7] Etheridge (92), p. 434.

DESCRIPTION OF THE SPECIMENS.

EQUISETALES.

Genus NEOCALAMITES.

? Neocalamites sp.

(Plate 5, fig. 3.)

Only one specimen amongst the hundreds from the Burrum Series can be definitely referred to the Equisetales. It is an impression of a jointed stem with leaves arranged in whorls at the nodes. The impression is about 4 mm. wide and the distance between the nodes 2 to 2·5 cm. The nodes are not distinctly shown in the specimen but they are evident from the arrangement of the leaves. The leaves are long (nearly 3 cm., incomplete), narrow (·75 mm. wide), and have no definite trace of a midrib ; they do not appear to be very numerous, probably only about 10 or 12 in a whorl.

This specimen is referred doubtfully to *Neocalamites*, and appears to be of the same type as *N. hoerensis*, already described from Ipswich,[8] with which it agrees in general form and in having few leaves in a whorl, but there does not appear to be a distinct median vein as is the case in that species.

Locality : Briton Shaft, ½ mile E.N.E. of Howard Railway Station (F. 41).

Figured Specimen : The original of Plate 5, fig. 3, is specimen F 41 in the Queensland Geological Survey Collection.

FILICALES.

? *OSMUNDACEÆ.*

Genus CLADOPHLEBIS.

Cladophlebis australis (Morris).

(Plate 3, figs. 6, 7.)

Normal fronds of the *Cladophlebis* type are comparatively common in the Burrum flora. They differ very little from the *Cladophlebis* type which is so abundant not only in the Triassic and Jurassic strata of Australia but in Jurassic rocks the world over. They are perhaps slightly less robust in general appearance than most of the specimens of *Cladophlebis australis* from the Walloon Series (Jurassic), but I have no hesitation in referring them to the same species. They are of the type with somewhat smaller pinnules

[8] Walkom (15), p. 33, t. 2, fig. 1.

and in which the secondary veins generally branch only once but occasionally do so twice. This more delicate form with the smaller pinnules accentuates the difference between the European *C. denticulata* and the Australian form.

Cladophlebis australis is a well-known type and has already been described in some detail from the Ipswich and Walloon Series[9]; it is not necessary to describe it in detail here.

The Burrum specimens are mostly in the form of carbonaceous impressions, and attempts have been made to secure preparations of the cuticle for examination under the microscope but without success; apparently the carbonisation has proceeded too far and the cell structures have been completely destroyed.

Two specimens from "Burrum, above the Bridge Seam" are of some interest. They show the general characters of normal *Cladophlebis* fronds, and in between the secondary veins there are elongated elevations probably indicating the presence of sori on the under surface. The appearance of these specimens is very similar to that of fertile fronds of the *C. denticulata* type such as figured by Seward from Jurassic rocks.[10] It seems somewhat doubtful whether this appearance of the upper surface would have been produced by sori such as have already been described on *Cladophlebis* fronds from Ipswich.[11] As these are the only specimens amongst those from Burrum which show any indication of fertile pinnules it is not possible to settle this point satisfactorily. Attention may be drawn to Seward's statement of the possibility of representatives of more than one family of ferns being included in the genus *Cladophlebis* as at present defined.[12]

Localities: Argyle Creek No. 1 Bore, 2 miles W. of Aldershot (F 1186); Bellert's Mine, Torbanlea (F 1187); Burrum, above the Bridge Seam (F 34, F 44); Clyde Colliery (F 1184); Takura No. 4 Government Bore, 4 miles S.W. of Takura Railway Station, at 600 feet (F 780) and at 1,008 feet (F 809); Takura No. 8 Government Bore, 4 miles W.S.W. of Takura Railway Station (F 796); Torquay Railway Cutting (F 1188); ? Turner's Selection, about ¾ mile N.N.E. of Burrum Railway Station (F 1183); Urangan No. 4 Government Bore, Pulgil Creek, 1 mile S. of Urangan Railway Station (F 1185).

Figured Specimens: The originals of Plate 3, figs. 6 and 7, are specimens F 801 and F 44 in the Queensland Geological Survey collection.

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[9] Walkom (17a), p. 3.
[10] Seward (10), p. 345.
[11] Walkom (17a), t. 7, fig. 1; t. 8, fig. 1.
[12] Seward (12), p. 15.

THINNFELDIEÆ.

Genus THINNFELDIA.

? Thinnfeldia lancifolia (Morris).

(For synonymy *see* Walkom (17*a*), p. 21.)

1892. *Thinnfeldia media* (?), Etheridge Jr., Geol. Pal. Qland., p. 315, t. 17, fig. 2.

It seems doubtful whether the specimen figured by Etheridge from the " Burrum Coalfield, near Maryborough " is really a *Thinnfeldia*. In the present collections there is only a single doubtful example of *Thinnfeldia* and this, with Etheridge's figure, is the only indication of the genus in the Burrum Flora. Mr. Dunstan has noted with regard to the type of Etheridge's figure " specimen crumbled to pieces, 15/6/14," so it is impossible to examine the original. The figure shows a very notable contraction of the pinnules towards the base, and in this respect a comparison with *Sphenopteris flabellifolia* is suggested. The presence of a distinct midrib and the shape of the pinnules indicate the species *lancifolia* if the specimen is a *Thinnfeldia*.

A specimen from near Howard is also referred with a little hesitation to the same species, and on account of the existence of this specimen it is proposed to transfer Etheridge's record of *T. media* (?) to *T. lancifolia* (Morris).

Localities: Burrum Coalfield, near Maryborough (Etheridge); near Howard (F 36).

? *DIPTERIDINÆ.*

Genus DICTYOPHYLLUM.

? Dictyophyllum sp.

(Plate 1, fig. 13.)

A few small specimens from Urangan No. 3 Government Bore probably belong to this genus. They are portions of leaves up to about 3 cm. long and 1·5 cm. broad. The margin of the leaf is divided into shallow lobes which are about 7 mm. long. There is a very well-defined midrib and from it a distinct secondary vein runs into each lobe; unfortunately, the specimen is not sufficiently well preserved to show any further details of the venation, though careful search has been made.

The general appearance of the specimens, with their lobed margins, is that of many examples of *Dictyophyllum*, a genus which

is of common occurrence on certain horizons of both Triassic and Jurassic rocks in Queensland.[13] On account of this general similarity to *Dictyophyllum*, I have doubtfully referred these specimens to that genus.

Attention must, however, be drawn to the possibility of these specimens being dicotyledonous leaves. My first impression on a casual examination of these specimens was that they were dicotyledonous, but on closer examination it appeared that they resembled *Dictyophyllum* too closely to be separated from it without adequate evidence.

The rocks in which these fossils occur are of Lower Cretaceous age, and there would be no reason for surprise if dicotyledonous leaves did occur as in the Mesozoic coal measures of the Styx River, some distance north of the Burrum area, the flora of which is described further on.

Locality: Urangan No. 5 Government Bore, Pulgil Creek, at 380 feet (F 810).

Figured Specimen: Figure 13, Plate 1, is drawn from specimen F 810 in the Queensland Geological Survey collection.

GENERA OF FERNS AND PLANTS INCERTÆ SEDIS.

Genus SPHENOPTERIS.

Sphenopteris flabellifolia (Tenison-Woods).

(Plate 3, figs. 9, 10.)

1883. *Sphenopteris* (*Aneimioides*) *flabellifolia*, Tenison-Woods, Proc. Linn. Soc. N.S.W., viii, p. 94.

1890. *Sphenopteris flabellifolia*, Feistmantel, Mem. Geol. Surv. N.S.W., Pal. No. 3, p. 91.

1892. *Sphenopteris flabellifolia*, Etheridge Jr., Geol. Pal. Qland., p. 314.

"Frond delicate, small, bipinnate; rachis terete, somewhat thick; pinnæ oblong, cuneate, contracted at the base to a delicate petiole; lower edge entire, upper divided into linear cuneate lobes of varying width, the edges straight or rounded, some of the pinnæ much elongated; costa inconspicuous; veins fine, close, numerous, straight, radiating." (*Tenison-Woods.*)

There are a few specimens from the Burrum Series which must be referred to this species. Tenison-Woods did not figure the

[13] Walkom (17a), p. 9.

species, nor has it yet been figured as far as I am aware. Perhaps the best indication as to its general appearance is the remark by Tenison-Woods that it bears a strong resemblance to *Archæopteris*.

In the typical pinnules the outer margin is lobed and denticulate ; the length of the pinnule is up to 25 mm. and at its widest part it measures about 10 mm., narrowing to less than 2 mm. at the point of attachment

The original description of the venation is somewhat vague. It is the typical Sphenopteroid venation with diverging, dichotomously dividing veins which are here usually nearly 1 mm. apart. The rachis is comparatively slender, its impression being only 2 mm. wide.

This species is quite distinct from any described Australian species of *Sphenopteris*. A resemblance may be noticed to some examples of *S. ampla* from Jurassic strata in Victoria figured by Stirling,[14] from which it differs in the nature of its outer margin. It is, however, quite unlike the great majority of figured examples of *S. ampla* and I have no doubt of it being quite distinct from that species.

Tenison-Woods' original specimen is probably in the Macleay Museum, at the University of Sydney. His reference to the resemblance to *Archæopteris* pinnules may be seen by comparing the figure given here with that given by Seward[15] (after Carruthers) of a pinnule of *A. hibernica*.

The species was originally described by Tenison-Woods[16] as occurring abundantly in a blue shale on the Burnett River, about halfway between Bundaberg and five coal-seams which abut on the river. This locality is known to be within the area covered by the Burrum Coal Measures.

Localities : Briton Shaft, $\frac{1}{4}$ mile S. of Burrum Railway Station (F 18) ; Burnett River, above Bundaberg (Tenison-Woods' locality) ; Dundee Colliery (F 844) ; Takura No. 3 Government Bore, $2\frac{1}{2}$ miles S.W. of Takura Railway Station, at 55 feet (F 54) ; Takura No. 6 Government Bore, 4 miles W. of Takura Railway Station, at 70 feet (F 815) ; Takura No. 8 Government Bore, 4 miles W.S.W. of Takura Railway Station (F 794) ; Torbanlea Government Bore, $1\frac{3}{4}$ mile N.E. of Torbanlea Railway Station, at 1,051 feet (F 1171) and at 1,200 feet (F 1168).

Figured Specimen : The original of Plate 3, fig. 9, is specimen F 1144 in the Queensland Geological Survey collection.

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[14] e.g. Stirling (00), Pl. 3, fig. 5.
[15] Seward (10), p. 564, fig. 369B.
[16] Tenison-Woods (83), p. 94.

Sphenopteris erecta (Tenison-Woods).

(Plate 5, figs. 4, 5.)

1883. *Sphenopteris* (*Aneimioides*) *flabellifolia*, var. *erecta*, Tenison-Woods, Proc. Linn. Soc., N.S.W., viii, p. 94, t. 2, fig. 2.

1890. *Sphenopteris flabellifolia*, var. *erecta*, Feistmantel, Mem. Geol. Surv. N.S.W., Pal. No. 3, p. 91.

1892. *Sphenopteris flabellifolia*, var. *erecta*, Etheridge Jr., Geol. Pal. Qland, p. 314.

Frond bipinnate; pinnules elongate, with denticulate margin, often notably lobed, contracted at base, sometimes to a short slender petiole; lower margin decurrent. The pinnules attain a length up to 15 mm. and at their widest part measure up to 4 mm. Venation typically Sphenopteroid.

The examples described by Tenison-Woods as *S. flabellifolia* var. *erecta* occurred on the same specimen as the larger *S. flabellifolia*, and regarding the variety he states "it seems a very different form [from *S. flabellifolia*], but on looking closely the venation and general shape of the lobes is seen to be the same."[17] Specimens of this type are amongst the commonest found in the Burrum Series, and having examined a large number of them I propose to raise Tenison-Woods' variety to the rank of a species. The two reasons he gave for describing it as a variety were the similarity of venation and of general shape of the lobes with those of *S. flabellifolia*.

The general shape of the pinnules is, however, quite distinct from that of the latter species, and as there is not much variation in the venation of many of the Sphenopterids there is no good reason for retaining this as a variety of *S. flabellifolia*; it has a much wider distribution than the latter and only occasionally occurs at the same locality.

Feistmantel[18] remarks that "the distinction of this fossil seems hardly to be justified even as a variety," and he is justified in this verdict on the descriptions and remarks of Tenison-Woods, and in the absence of a figure of *S. flabellifolia*.

Etheridge[19] retains it as a variety on the ground of its occurrence on the same slab as *S. flabellifolia*, "although individual specimens here and there differ widely"—hardly a valid reason.

All the specimens referred to this species are sterile fronds, and it is not possible to refer them to any more definite genus than *Sphenopteris*.

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[17] Tenison-Woods (83), p. 94.
[18] Feistmantel (90), p. 91.
[19] Etheridge (92), pp. 314-5.

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The fronds, however, show fairly close resemblance to many from the Mesozoic deposits, amongst which may be noted the following :—*Coniopteris burejensis* (Zalessky) from the Jurassic floras of Cape Lisburne[20] (N. America) and also of Amurland[21]; *Ruffordia acrodentata* (Fontaine) from the Lower Cretaceous of Virginia and Maryland[22]; *Onychiopsis Mantelli* from the Uitenhage Series of South Africa[23]; and many figures of *Coniopteris hymenophylloides*.

In the absence of fertile specimens it is not possible to carry out accurate determination.

Localities : Argyle Creek No. 1 Bore, 2 miles W. of Aldershot (F 1165) ; Briton Shaft, $\frac{1}{2}$ mile E.N.E. of Howard Railway Station ; Burnett River, halfway between Bundaberg and Five Coal Seams (Tenison-Woods) ; Burrum (F 37) ; Burrum No. 2 Government Bore, Dundee Colliery, $\frac{3}{4}$ mile S.E. of Howard Railway Station, at 351-353 feet (F 1159, 1160) ; Burrum No. 4 Government Bore, $\frac{1}{2}$ mile S.E. of Howard Railway Station (F 1158) ; Clyde Colliery (F 7) ; Portion 43, Urangan (F 575) ; Takura No. 4 Government Bore, 4 miles S.W. of Takura Railway Station, at 30 feet (F 64) and at 140-150 feet (F 65) ; Takura No. 6 Government Bore, 4 miles W. of Takura Railway Station, at 120 feet (F 817) ; Takura No. 8 Government Bore, 4 miles W.S.W. of Takura Railway Station (F. 795) ; Torbanlea Government Bore, $1\frac{3}{4}$ mile N.E. of Torbanlea Railway Station, at 980 feet (F 456), at 454, 887, and 914 feet (F 463), and at 1,200 feet (F 15) ; Walsh's No. 2 Riverbank Bore, Burrum, at 227 feet (F 93).

Figured Specimen : The original of Plate 5, fig. 4, is specimen F 18, in the Queensland Geological Survey collection.

Sphenopteris burrumensis, sp. nov.

(Plate 1, fig. 5.)

Rachis slender, longitudinally grooved ; pinnules up to about 1·8 cm. long and 6 mm. broad, obtusely rounded, narrowed at base ; midrib not prominent and not reaching to apex ; secondary veins coming off at an acute angle, branching dichotomously and somewhat arched ; veins in lower part of pinnules coming direct from rachis.

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20 Knowlton (14), Pl. 5, fig. 1.
21 Seward (12a), t. 1, figs. 1-2a.
22 Berry (11), t. xxiii, figs. 5, 6.
23 Seward (03), t. 1.

This species is based on a few specimens from Burrum which are distinct from any other Queensland examples. They resemble in some respects the species *S. otagoensis* and *S. owakaensis* described from the ? Rhætic beds of New Zealand by Arber.[24]

Localities : Burrum No. 2 Government Bore, Dundee Colliery, ¾ mile S.E. of Howard Railway Station, at 120 feet (F 1153) and at 600-700 feet (F 1154) ; (F 94) " Burrum."

Figured Specimen : Figure 5, Plate 1, is drawn from specimen F 1154 in the Queensland Geological Survey collection.

Genus CHIROPTERIS.

? Chiropteris sp.

(Plate 1, fig. 11.)

A single specimen and its counterpart show portion of a leaf with a clearly reticulate venation. The shape of the leaf is not shown, but from the slight divergence of the veins it appears probable that the leaf may have been fan-shaped or orbicular—the disposition of the veins indicates that the specimen does not belong to such a genus as *Sagenopteris*.

The veins form a narrow elongate mesh, being almost 1 mm. apart (6 to 7 in 5 mm. width), the anastomoses being about 5 mm. apart.

Examination with oblique light under the microscope shows that, in addition to the prominent veins visible to the naked eye, there is a series of very fine transverse connections between the veins, the fine veins being approximately at right angles to the coarser ones.

I have referred the specimen very doubtfully to *Chiropteris*. The venation and probable shape of the leaf suggest this reference. On the other hand the presence of the series of very minute cross-veins suggests affinity with some of the Dipteridinæ, but in none of the latter with which I am acquainted is there the elongate network of primary veins similar to that of *Chiropteris*.

Locality : Burrum No. 1 Government Bore, Riverbank Colliery, ¾ mile S.E. of Burrum Railway Station, at 419 feet (F 1150).

Figured Specimen : Figure 11, Plate 1, is drawn from specimen F 1150 in the Queensland Geological Survey collection.

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[24] Arber (17), p. 43.

Genus PHYLLOPTERIS.

In referring certain Queensland specimens to this genus I do not agree with the late Dr. Arber in his belief that the Queensland examples which have been referred to *Phyllopteris Feistmanteli* are generically identical with the specimens he described recently from New Zealand, and which he referred to a new genus, *Linguifolium*.[25]

Arber has given a full account of the history of *Phyllopteris* and pointed out that the two species originally referred to this genus belong to *Sagenopteris*. Saporta, in 1873, revived the term *Phyllopteris* for some French specimens which agreed with the description given by Brongniart. After showing that Brongniart's original species should not be kept in the genus *Phyllopteris*, Saporta goes on : " Cependant, même en adoptant ce point de vue, nous n'en conservons pas moins le genre *Phyllopteris*, tellement sa notion s'adapte bien à l'espèce de Hettanges que nous allons décrire et qui ne saurait, à cause de la direction oblique de ses nervures secondaries, être rangée parmi les vrais *Taeniopteris*. Ce genre, pour lequel nous adoptons la définition proposée par M. Brongniart, appartiendrait à l'Infra-Lias et peut-être aussi à l'Oolithe."[26]

With this clear definition of the position of *Phyllopteris* by Saporta there should be no great confusion in the use of the name, and I do not see why it should be abandoned entirely. Arber's main reason for replacing it by *Linguifolium* seems to be to avoid the little confusion which has arisen over the use of the name *Phyllopteris*.

However, quite apart from my view that the name *Phyllopteris* can be retained without causing confusion, I am not sure that the Australian specimens of *Phyllopteris* can be referred to Arber's description of *Linguifolium*.

The published descriptions and figures of the Australian species, *Phyllopteris Feistmanteli*,[27] were somewhat fragmentary and hardly justify their reference to *Linguifolium* ; the leaf is lanceolate rather than tongue-shaped, it does not show a gradual tapering towards the base, the midrib is not particularly prominent, and the secondary veins are more arched.

From the examination of specimens from the Burrum Series we may add to the points of difference between *L. Lillieanum* and the Australian forms. In the latter the apex of the leaf is somewhat pointed rather than rounded, and the base narrows sufficiently

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[25] Arber (17), p. 36.
[26] Saporta (73), p. 449.
[27] Etheridge (92), p. 375 ; (92a), p. 3, t. 1, figs. 1, 2.

quickly to be somewhat acutely rounded and ends in a short petiole by which it is attached to the rachis. The base of the leaf is very similar to that in such recent ferns as *Marattia*.[28]

In addition to these differences in individual characters, the general shape and appearance are quite distinct from *L. Lillieanum*, the New Zealand species.

In dealing with these form-genera a definition to include the Australian specimens would have to be much broader than that given by Arber for *Linguifolium*.

I propose therefore that the name *Phyllopteris*, as used by Saporta, be retained for these Australian plant remains, in preference to establishing a new generic name for them.

Arber has referred to the possibility of using the generic name *Lesleya* for these remains. There is a considerable degree of similarity between *Lesleya* and the plants under consideration, but as the former occurs in Upper Palæozoic rocks of Europe and America and also Rhætic of Chili it is perhaps better not to refer Australian Jurassic and Cretaceous examples to the same genus without more evidence than is available at present.

The following may be regarded as a diagnosis of the genus *Phyllopteris* based chiefly on Saporta's reference of French specimens to the genus :—Leaves simple, more or less lanceolate, having a short petiole and entire or denticulate margin ; median vein becoming thin towards the apex ; secondary veins springing from the midrib at an acute angle, distinctly arched and dividing dichotomously, not anastomosing.

Phyllopteris lanceolata, sp. nov.

(Plate 3, figs. 1, 2, 3.)

Frond bipinnate, rachis narrow ; pinnæ simple, alternate, oval-lanceolate, tapering rapidly at base and attached to rachis by a short petiole, apex acutely or somewhat obtusely pointed ; length of pinnæ up to about 5·5 cm., breadth to 1·3 cm. ; margin entire or denticulate. Midrib distinct but not persisting to the tip ; secondary veins making an acute angle with midrib, decidedly arched, close together (about 10 veins in 5 mm. at the margin) and bifurcating once or twice before reaching the margin.

[28] Seward (10), fig. 245A, p. 320.

Specimens of this species are very numerous among the Burrum plants. There is not much variation in the size of the leaves, and the majority of the examples are in the form of isolated pinnæ; the shape of these pinnæ is very constant.

In a number of features this species differs from the Jurassic examples of *Phyllopteris* (*P. Feistmanteli*) in Queensland. The pinnæ are not so large as in the latter species and the veins are closer together; in general appearance the two differ considerably, *P. Feistmanteli* apparently being a more robust type. In *P. lanceolata* the margin is occasionally distinctly denticulate. In addition we may take into consideration the difference in age—*P. Feistmanteli* occurs in the Walloon Series (Jurassic) which is separated from the Burrum Series by a considerable thickness of marine strata. A number of plants have been found in this marine series but so far *Phyllopteris* is not included in these.

It is possible that *P. lanceolata* is a later, modified form of *P. Feistmanteli*, but on account of their differences and the absence of any such form in the intervening Series we cannot say that they are one and the same species.

P. lanceolata is one of the commonest and most characteristic plants in the Burrum Series.

Localities: Argyle Creek No. 2 Bore, 2 miles W. of Aldershot, at 339 feet (F 1172); Briton Shaft, $\frac{1}{4}$ mile S. of Burrum Railway Station (F 26); Burrum (F 21); Burrum No. 3 Government Bore, Dundee Colliery, $\frac{1}{2}$ mile E.S.E. of Howard Railway Station, at 122 feet (F 1156) and at 163 feet (F 1174); Portion 43, 3 miles S. of Urangan Railway Station (F 1204); Takura No. 4 Government Bore, 4 miles S.W. of Takura Railway Station, at 140-150 feet (F 65), at 600 feet (F 783), at 624 feet (F 774), at 800 feet (F 787), at 919 feet (F 807), and at 989 feet (F 808); Urangan No. 4 Government Bore, at 164-174 feet (F 756); Urangan No. 5 Government Bore, Pulgil Creek, at 150 feet (F 757); Takura No. 8 Government Bore, 4 miles W.S.W. of Takura Railway Station, at 282 feet (F 822) and at 363-373 feet (F 791); Torbanlea Government Bore, $1\frac{3}{4}$ mile N.E. of Torbanlea Railway Station, at 98, 699, 712, and 730 feet (F 449), and at 800, 810, 880, 876 feet (F 450); Torquay Railway Cutting (F 13); Torquay Railway Station (F 1173); Turner's Selection, about $\frac{3}{4}$ mile N.N.E. of Burrum Railway Station (F 2).

Figured Specimens: The originals of Plate 3, figs. 1, 2, are specimens F1*a* and F1*b* in the Queensland Geological Survey collection.

Phyllopteris expansa, sp. nov.

(Plate 5, figs. 1, 2.)

Frond bipinnate, rachis slender; pinnæ large, ovate, more than 8 cm. long, 5 cm. wide at widest part, attached to rachis by a short petiole; margin of pinnæ broken into a number of shallow lobes which are about 7 or 8 mm. across. Midrib distinct but not persisting to the apex; secondary veins emerge at an acute angle from the midrib, slightly arched and divide dichotomously once or twice before reaching the margin; they are close together, about 8 to 10 in 5 mm. at the margin.

In general habit this species resembles the preceding one (*P. lanceolata*) but it is a much larger form. The secondary veins are not so strongly arched as in that species, and the margins of the pinnæ are distinctly lobed. These characters easily serve to distinguish between the two species.

There is a tendency for the lamina to become split parallel to secondary veins, particularly in the upper part of the pinnæ. This is perhaps natural in a comparatively wide leaf with well-developed venation, and it gives to the lamina an appearance not unlike that of fronds of certain cycads.

The specimens are very similar to the portion of a leaf figured by Saporta and referred by him to *P. plumula*. It was for this latter species, from the Jurassic Strata of France, that Saporta revived the use of Brongniart's generic term *Phyllopteris*. *P. expansa* may prove to be a synonym of *P. plumula*, Saporta,[29] but it is not felt that we are justified at present in uniting under the one name fragmentary specimens from strata of different ages in such widely separated areas. It may be noted that Arber transferred *P. plumula* to his newly proposed genus *Linguifolium*,[30] a suggestion with which I do not agree.

Locality: Dayman Point, Urangan (F 771), (F 814).

Figured Specimen: The original of Plate 5, fig. 1, is specimen F 771 in the Queensland Geological Survey collection.

Genus MICROPHYLLOPTERIS.

Arber has recently instituted this generic name for certain fronds from New Zealand with small leaflets, of which he remarks[31] (p. 38):—"Among the fern-like fronds of Mesophytic age occurring in New Zealand there are specimens which by most authors would

[29] Saporta (73), t. 63, fig. 6.
[30] Arber (17), p. 37.
[31] Arber (17), p. 38.

be unhesitatingly referred to the genus *Gleichenites* Goepp. Similar fronds are found not infrequently in Mesozoic rocks elsewhere, and have been generally regarded as the leaves of ferns closely allied to, if not identical with, the modern fern *Gleichenia*. This may be the case, but, so far as the present evidence of the earlier Mesozoic examples is concerned, it must be admitted that it rests entirely on a similarity of frond-habit (which is notoriously untrustworthy as a guide to affinity) and not on any precise knowledge of the fructification. Further, there is little doubt that the genus *Gleichenites*, even if it is to include the Mesophytic types in question, is a thoroughly bad one, incapable of being defined compactly or concisely. If we look into the origin of the term we find that it was instituted for Palæozoic plants now long ago transferred to other genera."

After having discussed various species of Upper Palæozoic and Lower Mesozoic plants which have been referred to *Gleichenites*, Arber goes on :—" I am well aware that, in the case of some of the Cretaceous and Tertiary fronds referred to *Gleichenites*, there are much better grounds for the belief in affinity to the living *Gleichenia* than exist in the case of the Jurassic species. My view is that if this term is used at all it is best preserved for cases where some further evidence than similarity of leaf-form has been found to exist."

His diagnosis of *Microphyllopteris* is :—" Fronds pinnate, bipinnate, or dichotomously branched ; pinnules small or very small, subcircular or ovate, closely set, broadest at the base, and attached by their whole base. Median nerve feeble, breaking up into simple or forked branches not far from the base of the pinnule."

Having made vain attempts to obtain a clear understanding of the Lower Mesozoic species referred to *Gleichenites* one cannot but feel that the use of a non-committal generic name, concisely defined as proposed by Arber, will do a great deal towards clearing up the confusion regarding these plants.

The only Queensland plant yet described which may be included in the genus *Microphyllopteris* was described as *Didymosorus ? gleichenoides*[32] Oldham and Morris from True Blue Hill, Croydon Goldfield, North Queensland, by R. Etheridge Jr. Arber[33] refers this to *Microphyllopteris*. The species had previously been referred to *Pecopteris* and *Gleichenites*, and, whilst provisionally referring it to a different genus, Etheridge states :—" Unfortunately for the purposes of strict identification, the specimens are preserved in a fine siliceous grit, which has obliterated all evidence of fructification, if any such existed, and also of the nervation."

[32] Etheridge (88), p. 1307, t. 38, fig. 3 ; also (92), p. 557.
[33] Arber (17), p. 39.

The only other Queensland specimens which have been referred to *Gleichenia* or *Gleichenites* are *Gleichenia lineata* and *G. dubia.* The former was described by Tenison-Woods[34] from the Rosewood Scrub, near Ipswich. The specimens are almost certainly *Thinnfeldias,* and I have referred them somewhat doubtfully to *T. acuta.*[35] Feistmantel and Etheridge simply followed Tenison-Woods in their record of this species.

Gleichenia dubia was described and figured by Feistmantel from the Wianamatta Beds in New South Wales. His specimens were also probably *Thinnfeldias, T. lancifolia* (Morris). Shirley described *Thinnfeldia* (*Gleichenia*) *dubia* Feist. from the Ipswich Series in the vicinity of Brisbane.[36] He says : " The Brisbane specimen agrees exactly with Feistmantel's description and plate. . . " Unfortunately the specimen which Shirley described is missing from the Geological Survey collection, and a comparison of his figure with that of Feistmantel does not inspire confidence in his determination of the Brisbane specimen. Such a record is useless, and *Gleichenia dubia* should not appear in the list of Queensland Mesozoic plants.

Of hitherto described plants then, the only representative that can be admitted into *Microphyllopteris* in the Queensland Mesozoic Flora is *M. gleichenioides* described by Etheridge from Croydon.

I believe that this species is well represented among the Burrum plants, and propose to add another species to include a few specimens which differ in certain respects from *M. gleichenioides.*

Microphyllopteris gleichenioides (Oldham and Morris).

(Plate 2, fig. 6.)

1862. *Pecopteris* (*Gleichenites*) *gleichenioides,* Oldham and Morris, Geol. Surv. India (Pal. Ind.) Gondwana Flora, i., pt. 1, p. 45, t. 25 ; t. 26, figs. 1, 3.

1888. *Didymosorus* (?) *gleichenioides,* Etheridge Jr., Proc. Linn. Soc., N.S.W., iii, p. 1308, t. 38, fig. 3.

1892. *Didymosorus* (?) *gleichenioides,* Etheridge Jr., Geol. Pal. Qland., p. 557.

Frond bipinnate ; pinnæ long and narrow, 4 cm. or more long ; up to 4 mm. wide ; rachis bears closely set subopposite or alternate pinnules which are small, 1-2 mm. long and about 1 mm. wide,

[34] Tenison-Woods (83), p. 130, t. 3, fig. 6 ; t. 8, fig. 2.
[35] Walkom (17a), p. 23.
[36] Shirley (98), p. 22, t. 23.

rounded, somewhat thick, and attached by the whole base ; venation indistinct, but there are traces of one or two veins in some of the pinnules.

These fossils are very similar in general appearance to many examples referred to *Gleichenites*, amongst which may be mentioned particularly *G. Zippei* (Corda)[37] and similar species figured by Heer from Lower Cretaceous (Urgonian) rocks of Greenland ; in the Greenland species, however, sori are preserved and there is some justification for the use of the name *Gleichenites*.

The Wealden plant referred by Seward[38] to *Nathorstia valdensis* was also a very similar type ; the name *Nathorstia*, however, had been used earlier by Heer for quite a different plant and the name *Leckenbya* was subsequently substituted by Seward.[39] These English specimens have the same general appearance as the Queensland ones, their venation also being indistinct and their fructification unknown. Similar small fragments have been figured from Wealden strata in Belgium.[40] *Leckenbya valdensis* was later placed as a synonym of *Gleichenites cycadina* (Schenk) by Seward[41] when describing Jurassic plants from Sutherland, Scotland.

The present specimens cannot be distinguished in their general form from the examples described by Etheridge from Croydon. The sedimentary rocks at Croydon, however, are almost certainly part of the Marine Cretaceous of Western Queensland, and therefore are equivalent to the Maryborough Series, which underlies the Burrum Series in Eastern Queensland.

Localities : Burrum No. 1 Government Bore, Riverbank Colliery, $\frac{3}{4}$ mile S.E. of Burrum Railway Station (F 1148) ; Dundee Colliery (1429) ; Urangan No. 4 Government Bore, Pulgil Creek, 1 mile S. of Urangan Railway Station (F 767).

Figured Specimen :—The original of Plate 2, fig. 6, is specimen 1429 in the University of Queensland collection.

Microphyllopteris acuta, n. sp.

(Plate 1, fig. 8.)

Frond (?) bipinnate ; pinnæ elongate and narrow, up to about 4·5 cm. in length and 3 mm. in width ; pinnules small, attached by whole base, obtusely rounded or occasionally somewhat acute, subopposite or alternate but not set close together, and making an acute angle with the rachis. Venation indistinct.

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[37] *See* Seward (10), p. 354.
[38] Seward (94), p. 145, t. 7, fig. 5.
[39] Seward (95), p. 225.
[40] Seward (00a), p. 24, t. 3, figs. 42-45 particularly.
[1] Seward (11), p. 664.

The specimens referred to here agree very well with *Microphyllopteris* except that the pinnules are not so closely set as in the typical examples, and the venation cannot be clearly seen. They only differ from *Microphyllopteris gleichenioides* in the more open arrangement of the pinnules and in having the pinnules somewhat more acute and inclined at an angle to the rachis.

Localities: Burrum No. 4 Government Bore, Dundee Colliery, ½ mile S.E. of Howard Railway Station, at 122 feet (F 1149); Takura No. 8 Government Bore, 4 miles W.S.W. of Takura Railway Station, at 180 feet (F 772).

Figured Specimen: Figure 8, Plate 1, is drawn from specimen F 1149 in the Queensland Geological Survey collection.

Genus STENOPTERIS.

Stenopteris elongata (Carruthers).

(Plate 1, fig. 10.)

(For synonymy *see* Walkom (17*a*), p. 40.)

Fragments referable to this species are of rather common occurrence in the Burrum Series. The species has been described in a previous paper thus :—"The frond is dichotomously branched, each branch being pinnate. The pinnæ may be simple, linear, or they may be pinnate to a varying extent; the segments are linear, usually somewhat bluntly pointed, and each possesses a single median vein. In some of the extreme forms the segments may be bi- or tri- lobed, each lobe having a single vein. The rachis frequently bears transverse markings similar to those noted in *Thinnfeldia* and *Sphenopteris*."[42]

The specimens from the Burrum Series are all fragmentary and do not enable us to add anything to the discussion of the species already given in describing the flora of the Ipswich and Walloon Series. All the Burrum specimens are long, simple, and about 1 mm. in width; they show, in general, a resemblance to the simpler and less pinnate types amongst those already figured from the Triassic and Jurassic strata,[43] and as a whole the Cretaceous examples appear to be simpler than the earlier forms.

The individual segments are not unlike the leaves of some of the Equisetales (*e.g. Neocalamites*) and in some cases it is practically impossible to determine isolated fragments.

The systematic position of this species is still uncertain.

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[42] Walkom (17a), p. 41.
[43] Walkom (17a), t. 6, figs. 2, 3.

Localities : Argyle Creek No. 2 Bore, 2 miles W. of Aldershot (F 1146) ; Briton Shaft, ¼ mile S. of Burrum Railway Station (F 24) ; Dayman Point (F 768) ; Takura No. 4 Government Bore, 4 miles S.W. of Takura Railway Station, at 160 feet (F 58), 550 feet (F 798), 800 feet (F 788) ; Takura No. 8 Government Bore, 4 miles W.S.W. of Takura Railway Station (F 773) ; Torbanlea Government Bore, 1¾ mile N.E. of Torbanlea Railway Station, at 711 and 811 feet (F 460) ; Portion 43, Urangan (F 1147).

Figured Specimen : Figure 10, Plate 1, is drawn from specimen F 1146 in the Queensland Geological Survey collection.

Stenopteris laxum (Tenison-Woods).

(Plate 3, fig. 5.)

1883. ? *Trichomanides laxum*, Tenison-Woods, Proc. Linn. Soc. N.S. Wales, viii, p. 97, t. 10, fig. 2.

1890. ? *Trichomanides laxum*, Feistmantel, Mem. Geol. Surv. N.S. Wales, Pal. 3, p. 94.

1892. *Trichomanites laxum*, Etheridge Jr., Geol. Pal. Qland., p. 315, t. 18, fig. 9.

Frond bi- or tri- pinnate, rachis slender ; pinnæ elongate, given off from rachis at acute angle ; segments linear, pointed, narrow, with a single median vein. The ultimate segments have a length up to about 4 mm. and breadth about ·25 mm.

The typical examples of this species are such as that figured by Etheridge.[44] The original of his figure is crumbling as a result of long exposure to the atmosphere and another specimen is figured here (Plate 3, fig. 5).

This plant appears to me to be of essentially the same type as *Stenopteris elongata*, except that it is much smaller and more delicate and I cannot find any good reason for not at present associating the two species. It is quite possible that ultimately the two may have to be united under a single species.

Judging from his original figure, the plant figured by Tenison-Woods[45] as *Trichomanides laxum* may be a *Sphenopteris*. His interpretation of the specimen is unintelligible ; on this point Etheridge[46] quotes the following remarks of Dr. Kidston :—" The characters of *T. laxum* are simply unintelligible. If Mr. Tenison-Woods supposed

[44] Etheridge (92), t. 18, fig. 9.
[45] Tenison-Woods (83), t. 10, fig. 2.
[46] Etheridge (92), p. 315.

his figure to represent a rhizome, as I am led to think from his description, there appears to be a mistake in the interpretation of the fossil, which more probably shows part of a compound frond."

Seward[47] has referred this species to the English Wealden species, *Onychiopsis Mantelli*. While there is a general similarity in the appearance of these sterile fronds to examples of *O. Mantelli*, there is perhaps as much similarity to sterile fronds of such ferns as *Ruffordia Göpperti*.[48] It would seem therefore, that, in the absence of more complete specimens and fertile fronds, it is not possible to refer this plant with certainty to any such definite genus as *Onychiopsis*, and it is thought advisable to leave it in the genus *Stenopteris* until our knowledge of it is more complete.

Localities: Briton Shaft, $\frac{1}{2}$ mile E.N.E. of Howard Railway Station (F 25); Burrum Coalfield (F 43)—(original of Etheridge's figure); Torbanlea Government Bore, $1\frac{3}{4}$ mile N.E. of Torbanlea Railway Station, at 138 and 178 feet (F 459).

Figured Specimen: The original of Plate 3, fig. 5, is specimen F 25 in the Queensland Geological Survey collection.

CYCADOPHYTA.

Genus PTILOPHYLLUM.

Ptilophyllum (Williamsonia) pecten (Phillips).

(Plate 3, fig. 4.)

A few small fragments of this characteristic type of frond are among the Burrum plants. They are portions of narrow fronds, about 1 cm. wide, with the typical pinnæ. These fronds have already been described both from the Walloon Series[49] and also from the Maryborough Series,[50] and there is no need to discuss them further here.

Localities: Takura No. 4 Government Bore, 4 miles S.W. of Takura Railway Station, at 930 feet (F 790); Torbanlea Government Bore, $1\frac{3}{4}$ mile N.E. of Torbanlea Railway Station, at 909 feet (F 455).

Figured Specimen: The original of Plate 3, fig. 4, is specimen F 455 in the Queensland Geological Survey collection.

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[47] Seward (94), p. 45.
[48] Seward (94), t. 4; t. 5, fig. 1.
[49] Walkom (17b), p. 14.
[50] Walkom (18) p. 10.

Genus ZAMITES.

"Fronds broadly lanceolate reaching a length of over 60 cm.; pinnæ more or less oblique or at right angles to the rachis, attached to the upper surface but not completely covering it, linear or linear-lanceolate, acuminate or obtuse, usually abruptly contracted at the rounded base and more rarely gradually tapering to the proximal end, with or without a callosity at the symmetrical base; veins divergent at the base, simple or dichotomously branched, for the most part parallel to the edges of the lamina and slightly divergent in the apical region."[51]

The genus *Zamites* has been the subject of considerable discussion[52]; it is used generally for cycadean fronds with entire pinnæ which are not truncate at the apex and not decurrent but are slightly constricted at the base. The definition given above is that of Seward in his "Fossil Plants," vol. iii, and in view of the fact that the term is applied to fronds it is not desirable to use a more precise definition in preference to this general one.

In the case of detached pinnæ it is not easy to distinguish between *Zamites* and the plants which are referred to *Podozamites*. The presence of a basal callosity in the former is a distinguishing feature but it is not always easy to be sure of this in fossil examples where the leaf usually becomes flattened. As pointed out by Seward[53] the flattening of the pinnæ against the rachis during fossilisation may produce a transverse wrinkling of the lamina which might suggest a basal thickening. The method of attachment of the pinnæ is distinct, but as both genera are perhaps most commonly represented by detached pinnæ or portions of pinnæ this distinction is not usually of practical value. It seems that the pinnæ of *Podozamites* are more lanceolate than those of *Zamites* and in the former genus the contraction at the base is often much more marked, as in a number of American species described by Berry,[54] than in *Zamites*.

Zamites ranges from Rhætic to Lower Cretaceous.

Zamites takuraensis, sp. nov.

(Plate 2, fig. 1.)

Pinnæ elongate, obtusely pointed, narrowing rather abruptly towards the base; well-marked articulation at the base. Veins

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[51] Seward (17), p. 531.
[52] *See* Seward (95), p. 75; (17), p. 529; Berry (11), p. 343.
[53] Seward (17), p. 531.
[54] Berry (11), pp. 336 *et seq.*; t. 53.

generally parallel, branching dichotomously occasionally, slightly convergent towards the apex. Presence of basal callosity somewhat doubtful.

The pinnæ are more than 10 cm. long and up to about 2 cm. wide at widest part; the veins are numerous, about 12 per cm. The very distinct basal termination observed in some examples suggests that the pinnæ probably became separated from the rachis by the development of a distinct abscise-layer.

Examples of this species are quite common in the Burrum Series and appear distinct from any form yet described from the Australian Mesozoic strata. They resemble to a marked degree the species *Z. Carruthersi* from the English Wealden[55] and also from Kimmeridge Beds[56] in Scotland; one point in which they differ from this species is in the veins not diverging at the apex but rather converging slightly. It is possible that a more complete knowledge of this species would show it to be synonymous with *Z. Carruthersi*.

Another species to which a resemblance may be noted is *Z. tenuinervis* Fontaine from the Lower Cretaceous rocks of Virginia and Maryland.[57]

Localities: Burrum No. 1 Government Bore, Riverbank Colliery, ¾ mile S.E. of Burrum Railway Station, at 245 feet (F 1189); Burrum No. 2 Government Bore, Dundee Colliery, ¾ mile S.E. of Howard Railway Station (F 1182); Burrum No. 3 Government Bore, Dundee Colliery, ½ mile E.S.E. of Howard Railway Station, at 254-256 feet (F 1191); Clyde Colliery (F 22); Dundee Colliery, Howard (F835); Takura No. 3 Government Bore, 2½ miles S.W. of Takura Railway Station, at 330 feet (F 60); Takura No. 4 Government Bore, 4 miles S.W. of Takura Railway Station, at 40 feet (F 57) and at 800 feet (F 805); Takura No. 5 Government Bore, 2½ miles S.W. of Takura Railway Station (F 764); Takura No. 8 Government Bore, 4 miles W.S.W. of Takura Railway Station, at 314 and 466 feet (F 793); Torbanlea Government Bore, 1¾ mile N.E. of Torbanlea Railway Station, at various depths between 847 feet and 1,234 feet (F 42, F 452, F 453); Torquay (F 1190); Turner's Selection, about ¾ mile N.N.E. of Burrum Railway Station (F 4).

Figured Specimen: The original of Plate 2, fig. 1, is specimen F 57 in the Queensland Geological Survey collection.

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[55] Seward (95), p. 86.
[56] Seward (11), p. 694.
[57] Berry (11), p. 345, t. 54, figs. 1-5.

Genus NILSSONIA.

Nilssonia schaumburgensis (?) (Dunker).

(Plate 1, figs. 14, 15.)

(For full synonymy *see* Seward (95), p. 53).

1846. *Pterophyllum schaumburgense*, Dunker, Wealdenbildung, p. 15, t. 1, fig. 7 ; t. 2, fig. 1 ; t. 6, figs.5-10.

1895. *Nilssonia schaumburgensis*, Seward, Wealden Flora, ii, p. 53, fig. 3.

Fragments of long narrow leaves are referred to *Nilssonia*. They are incomplete and give no indication of the length of the pinna, which is a little over 1 cm. in width. The lamina is broken up into a number of rounded obtuse segments, whose width varies from about 5 mm. to a little more than 1 cm. They are attached to the upper surface of the rachis but the lamina does not entirely cover the upper surface. These segments are traversed by a number of parallel veins, which are close together (about 17 in a space of 5 mm.) and normally do not branch ; very occasionally they can be observed to branch once quite close to the rachis.

The only other specimen which I have been able to definitely assign to *Nilssonia* from the Queensland Mesozoic Flora is from the Cretaceous rocks of Western Queensland which are probably of the same age as the Burrum Series. This specimen was referred to *Nilssonia mucronatum* (De Vis),[58] and is quite distinct from the present specimens. These specimens may be compared most closely with *N. schaumburgensis* (Dunker), a Wealden species from many localities in Europe and from Japan, and on account of its close resemblance to that figured by Seward[59] from the English Wealden I have suggested that it may belong to that species.

Localities : Burrum No. 1 Government Bore, Riverbank Colliery, ¾ mile S.E. of Burrum Railway Station (F 1151, 1178) ; Takura No. 3 Government Bore, 2½ miles S.W. of Takura Railway Station (F 55).

Figured Specimens : Figures 14 and 15, Plate 1, are drawn from specimen F 1178 in the Queensland Geological Survey collection.

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[58] Walkom (16), p. 231, t. 24.
[59] Seward (95), p. 55, fig. 3c.

Nilssonia mucronatum (De Vis).

(Plate 6.)

1911. *Pterophyllum mucronatum*, De Vis, Ann. Qland. Mus., 10. p. 1, t. 2.

1916. *Nilssonia mucronatum*, Walkom, Mem. Qland. Mus., v, p. 231, t. 24.

A single specimen from the Cretaceous of Western Queensland was described by De Vis as *Pterophyllum mucronatum*. The rocks from which this specimen came are almost certainly the equivalents in Western Queensland of the Burrum Series. On account of discrepancies between the description and figures of this species by De Vis, I made a fresh examination of the specimen, and the following remarks are quoted from the published results of that re-examination[60]:—

"The specimen is a single incomplete pinnate frond; it has a length (incomplete) of 12·5 cm. and is 5·8 cm. wide at its lowest end and 4·8 cm. at the upper end.

"The pinnæ are alternate, fairly uniform in shape and size, and are close together; they are from 2·6 cm. to 3 cm. long and 6 to 7 mm. wide; they are inserted on the upper surface of the rachis which has a width of from 1·5 to 2 mm. The pinnæ narrow very slightly near their junction with the rachis; the upper margins of the pinnæ are straight and make a wide angle (about 80°) with the rachis; the lower margins are at first parallel with the upper, but they curve upwards rather suddenly at a distance of about 2·5 cm. from the rachis, forming truncated pointed tips to the pinnæ.

"The venation is not well defined, but as far as can be seen there are 10 to 12 veins per pinna and they appear to be very slightly divergent (*see* Plate 6, fig. 3).

"The specimen shows the frond viewed from the lower surface, but over the greater part the actual material of the pinnæ has been removed, leaving the impression of the upper surface. At a few places the material replacing the pinnæ is preserved and it is on these that the venation can best be observed.

"The rachis projects markedly above the level of the remainder of the frond and so it hides, for the most part, the manner of attachment of the pinnæ to the rachis. Fortunately in one or two places the rachis is broken away and the pinnæ are seen to have continued

[60] Walkom (16), pp. 231-2.

almost to the middle of the rachis before joining it. This method of attachment at once shows that the specimen was incorrectly placed in the genus *Pterophyllum*, where the attachment is lateral.

"The general appearance of the frond, the method of attachment of the pinnæ and their general shape, particularly the truncate tips, are characteristic of *Nilssonia*. In the slight narrowing of the pinnæ near the base the specimen diverges from the typical *Nilssonia*. An apparent slight divergence of the veins is mentioned in the description. The venation only shows on portions of a few pinnæ and it is quite possible that the slight apparent divergence is accidental.

"Neither of these two differences from the typical *Nilssonia* is sufficiently marked to warrant a separation without further material."

The specimen shows an approach to some Wealden examples of *N. schaumburgensis* (Dunker).

Locality: Wyangarie Station, on O'Connell Creek, south of Richmond, Q. (F15/967 in Queensland Museum).

Figured Specimen: The original of Plate 6, fig. 1, is specimen F 15/967 in the Queensland Museum collection. The figures are reproduced from the memoirs of the Queensland Museum, vol. v, pl. 24.

Genus OTOZAMITES.

Otozamites ? sp. ind.

Etheridge figured a fragment from "Burrum, above Bridge Seam," which he referred to *Otozamites* sp. The original specimen crumbled to pieces as a result of long exposure to the atmosphere. No further specimens having been found it is only possible to repeat Mr. Etheridge's remarks, which were as follows:—"This fragment would appear to indicate a species of *Otozamites*, differing from *O. Mandeslohi* in its much larger, fuller, and more pyriform pinnules. A larger pinnule lying near the figured example has an excavate base, which heightens the resemblance to this genus. The veins were probably distinct and well marked, and under twenty in number. It may be compared to *Otozamites Beanii*, Lindley and Hutton, from the Yorkshire Oolites, or *O. Canossæ*, Zigno, from beds of similar age in Italy."[61]

Locality: Burrum, above Bridge Seam (Etheridge's locality).

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[61] Etheridge (92), p. 318.

? CYCADOPHYTA.

Genus TÆNIOPTERIS.

Tæniopteris spatulata, McClelland (= T. Daintreei, McCoy).

(Plate 1, fig. 9.)

(For synonymy *see* Walkom (17*a*), p. 30.)

Amongst the Burrum collection there are a few small specimens of this typical species of *Tæniopteris*. They are portions of a narrow, parallel-sided, strap-shaped leaf with a prominent midrib and secondary veins at right angles, or nearly so, to the midrib. The leaf is up to about 1·cm. wide and the prominent midrib up to about 1 mm. wide; the secondary veins are fairly close there being about 19 in a space of 7 mm. These veins are usually simple but occasionally they fork before reaching the margin.

In some examples there is a distinct upward curving of the secondary veins as they approach the margin; this has been noted before in the case of similar specimens from the Jurassic strata of Stewart's Creek, near Rockhampton.[62]

Tæniopteris spatulata (= *T. Daintreei*) has been recorded from numerous localities in the Walloon Series (Jurassic) and its equivalents in Queensland, and from the Styx River Series, which is further north than the Burrum Series and is an isolated series of coal measures.

Localities: Argyle Creek No. 2 Bore, 2 miles W. of Aldershot, at 321 feet (F 1175); Burrum No. 3 Government Bore, Dundee Colliery, $\frac{1}{2}$ mile S.E. of Howard Railway Station (F 1177); Torbanlea Government Bore, $1\frac{3}{4}$ mile N.E. of Torbanlea Railway Station, at 800 feet (F 458); Urangan No. 5 Government Bore, Pulgil Creek, at 280 feet (F 758); Urangan No. 4 Government Bore, Pulgil Creek, 1 mile S. of Urangan Station (F 760).

Figured Specimen: Figure 9, Plate 1, is drawn from specimen F 1176 in the Queensland Geological Survey collection.

Tæniopteris howardensis, sp. nov.

(Plate 1, fig. 1.)

Leaf elongate, with an obtuse apex and gradually narrowing towards the base; breadth of leaf up to 1·4 cm., length ?; midrib

[62] Walkom (17a), p. 31.

distinct, about ·75 mm. wide, striated longitudinally; secondary veins at a wide angle to midrib frequently branching, very close together, there being about 21 in a space of 4 mm. at the margin of the leaf.

No form quite similar to this has been found in our Lower Mesozoic rocks; some of the previously described species have a similar general form but in none of them is the secondary venation the same. Such species as *T. spatulata*, from both Jurassic and Cretaceous rocks of Queensland, and *T. arctica*, from the Cretaceous (Neocomian) of New Zealand, have the same general appearance but the secondary veins are not nearly so close together as in the specimens being described here. Another Cretaceous species with which comparison may be made is *T. Beyrichii* and here again the secondary venation is distinct.

Localities: Burrum No. 2 Government Bore, Dundee Colliery, ¾ mile S.E. of Howard Railway Station (F 1182); Burrum No. 3 Government Bore, Dundee Colliery, ½ mile E.S.E. of Howard Railway Station (F 1180); Burrum No. 4 Government Bore, Dundee Colliery, ½ mile S.E. of Howard Railway Station (F 1181); Hanley No. 2 Bore, 3 miles N. of Howard Railway Station, at 107 feet (F 31); Riverbank Colliery, Burrum (F 1231); Takura No. 6 Government Bore, 4 miles W. of Takura Railway Station, at 100 feet (F 816).

Figured Specimen: Figure 1, Plate 1, is drawn from specimen F 1231 in the Queensland Geological Survey Collection.

Tæniopteris sp.

Specimens from a single locality show a *Tæniopteris* with rather a broader leaf than any others from the Burrum Series. The leaf is 2·3 cm. wide with a prominent midrib about 1 to 1·5 mm. wide. The secondary veins are numerous, branch dichotomously at frequent intervals, and are practically at right angles to the midrib; there are about 14 of these secondary veins in a space of 4 mm.

These specimens appear to be of the same type as *T. Carruthersi* but the veins are much closer together. They also show a resemblance to *T. elongata* from the Maryborough Series with which species they are probably identical, though there is a difference in general appearance, and whilst dealing only with small fragments it hardly seems justifiable to definitely assign them to that species.

Locality: Burrum No. 1 Government Bore, Riverbank Colliery, ¾ mile S.E. of Burrum Railway Station (F 1258).

GINKGOALES.

Genus GINKGO.

Ginkgo digitata (Brongniart).

(Plate 1, figs. 3, 4.)

(For full synonymy *see* Seward (00), p. 254.)

1917. *Ginkgo digitata*, Walkom, Qland. Geol. Surv. Pub. 259, p. 8, t. 1, figs. 3-5.

1918. *Ginkgo digitata*, Walkom, Qland. Geol. Surv. Pub. 262, p. 9.

Small leaves with slender petiole; lamina 2 to 2·5 cm. from base to outer margin and 2 to 2·5 cm. across, outer margin lobed more or less deeply; number of lobes up to about six, with obtusely rounded ends; edges of lamina make an obtuse angle with the petiole; veins spreading, dichotomously branching, fairly numerous, 8 to 10 in a space of 5 mm.

These leaves, which cannot be distinguished from many of the smaller examples of *Ginkgo digitata*, show very well the variation in form of such leaves. On a single slab there can be seen a number of examples, all approximately the same size, but showing a considerable variation in the degree to which the lamina is divided. There is no doubt that they all belong to a single species and they illustrate the difficulty of dealing with fossil *Ginkgo* leaves. The variety in leaf-form displayed by leaves from a single tree of the recent species *G. biloba* has been illustrated by Seward,[63] and there is no doubt that we have to deal with a similar degree of variation in describing fossil forms.

Examples of *G. digitata* similar to the specimens described here have been recorded from many series of Jurassic strata, and the type has a very wide geographical range.[64]

Localities: Burrum No. 3 Government Bore, Dundee Colliery, ½ mile S.E. of Howard Railway Station (F 1192); Dudley Colliery (F 10); Dundee Colliery (F 9, F 16); Takura No. 4 Government Bore, 4 miles S.W. of Takura Railway Station, at 161-171 feet (F 59), at 600 feet (F 802), and at 919 feet (? F 806).

Figured Specimens: Figures 3 and 4, Plate 1, are drawn from specimen F 10 in the Queensland Geological Survey collection.

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[63] Seward (11a), t. 5.

[64] Seward (00), p. 254, t. 9, figs. 9, 10; Seward (11), t. 3, f. 40; Knowlton (14), t. 7, figs. 4, 5, &c.

Genus BAIERA.

Baiera bidens (Tenison-Woods).

1883. *Jeanpaulia bidens*, Tenison-Woods, Proc. Linn. Soc. N.S. Wales, 8, p. 132, t. 4, fig. 3.

1898. *Ginkgo bidens*, Shirley, Proc. Roy. Soc. Qland., 12, p. 74, t. 6.

1898. *Ginkgo bidens*, Shirley, Qland. Geol. Surv. Bull. 7, p. 12, t. 19, fig. 1 ; t. 21.

1917. *Baiera bidens*, Walkom, Qland. Geol. Surv. Pub. 259, p. 11, t. 3, figs. 1, 2.

In the present collection there are no examples of this species. The specimen originally described as *Jeanpaulia bidens* by Tenison-Woods, however, came from the Burrum Series, the locality being Burnett River coal-seams. The original specimen is probably in the Macleay Museum in the University of Sydney.

Locality : Burnett River coal-seams (Tenison-Woods).

CONIFERALES.

Genus ARAUCARITES.

Araucarites (?) polycarpa (Tenison-Woods).

(Plate 1, fig. 16.)

A single imperfectly preserved impression of a cone of the type described by Tenison-Woods as *Araucarites polycarpa* has been found in a relatively coarse sandstone near Pialba. It shows the impression of the surface, with the rhomboidal ends of the cone-scales distinctly outlined. These rhomboidal markings are about 4·5 mm. x 2 mm. and their spiral arrangement is clearly indicated. The specimen doubtless represents an Araucarian cone but it is impossible to determine it with any attempt at accuracy. It is obviously quite distinct from cones which are represented by the isolated seed-scales described below. It may be similar to that already described from Stewart's Creek, Rockhampton.[65] The specimen of a cone originally described as *Araucarites* (?) *polycarpa*[66] is described as having come from " a conglomerate partly derived from the coal-beds of the Burnett River, Q., but it may be of subsequent date or even Tertiary." From the similarity in general appearance between Tenison-Woods' figure and the present specimen

[65] Walkom (17b), p. 24.
[66] Tenison-Woods (83), p. 165 t. 10 fig. 1.

I have no doubt they are similar types of cone, and the probability is that the original specimen came from the Burrum Series in the neighbourhood of the Burnett River.

Locality : Urangan Point, Pialba (F 30).

Figured Specimen : Figure 16, Plate 1, is drawn from specimen F 30 in the Queensland Geological Survey collection.

Araucarites Arberi, sp. nov.

(Plate 2, figs. 7, 8.)

Seed-scales broadly wedge-shaped, apex broad, generally narrowing to a relatively narrow base ; apex often prolonged into a long narrow spine. Seed single, elongate.

These scales attain a length of about 2 cm. ; they are 1 to 1·3 cm. broad at the apex of the body of the scale and narrow to about 4 mm. at the base ; from the broad apex a gradually tapering spine projects in many cases ; this spine is about 3 or 4 mm. wide at its base and reaches a length of 1·5 cm. There is a single elongate depression (about 1 to 1·3 cm. long and 3-4 mm. broad) marking the position of the seed. In most cases there is no trace of the actual seed, but in one or two specimens the depression is occupied by a small mass of carbon which appears to represent the carbonised remains of the actual seed.

These seed-scales are very similar to scales of recent species of *Araucaria* [67] and there is no doubt that they represent definite Araucarian remains.

Isolated seed-scales of Araucarian cones have not previously been described from Queensland. They are apparently of frequent occurrence in the Burrum Series and are here recorded from a number of localities. They offer the most definite evidence we have of the presence of plants with Araucarian affinities in the Queensland Mesozoic Floras.

These Queensland specimens are distinct in general appearance from those figured by Feistmantel from the Upper Gondwana System in India as *Araucarites cutchensis*.[68]

The difference between the two, together with the difference in their age, seems to warrant specific separation of the Queensland examples, which are here referred to a new species, *Araucarites Arberi*.

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[67] *See* Seward and Ford (06), p. 359, fig. 24.

[68] Feistmantel (77), p. 16-96, t. 14.

Similar specimens have been described from Lower Mesozoic strata in New Zealand by Arber.[69]

These scales are found in association with coniferous sterile shoots such as *Pagiophyllum* and *Podozamites*, and while there is no definite evidence of connection it would seem probable that there is some relation between one of these genera and the cones; at present I am inclined to consider it more probable that this relation is with the leaves which we refer to *Podozamites* in view of my description of a specimen, from the Maryborough marine Cretaceous strata,[70] in which leaves of this type are definitely connected with portion of what is considered to be an Araucarian cone.

Localities: Burrum No. 1 Government Bore, Riverbank Colliery, ¾ mile S.E. of Burrum Railway Station, at 419 feet (F 1150); Dayman Point, Urangan (F 769); Portion 43, Urangan (F 1196, F 1270); Takura No. 4 Government Bore, 4 miles S.W. of Takura Railway Station, at 620 feet (F 803); Torbanlea Government Bore, 1¾ mile N.E. of Torbanlea Railway Station, at 230, 240, 862, 890, 1,132, and 1,186 feet (F 451); Torquay Railway Cutting (F 1197); Urangan No. 4 Government Bore, Pulgil Creek, 1 mile S. of Urangan Railway Station (F 762).

Figured Specimens: The originals of Plate 2, figs. 7, 8, are specimens F 1197 and F 1196 in the Queensland Geological Survey collection.

Genus BRACHYPHYLLUM.

Brachyphyllum crassum (Tenison-Woods).

(Plate 1, fig. 12.)

1883. *Brachyphyllum australe*, var. *crassum*, Tenison-Woods, Proc. Linn. Soc. N.S.W., 8, p. 159, t. 5.

1892. *Brachyphyllum crassum*, Etheridge, Geol. Pal. Qland., p. 385, t. 18, fig. 2.

1917. *Brachyphyllum crassum*, Walkom, Geol. Surv. Qland. Pub. 259, p. 25, t. 9, fig. 1.

This species is represented among the plants from the Burrum Series by a couple of poorly preserved specimens. They have the general appearance and dimensions of the smaller branches of the species, and there is no doubt of their belonging to this species, which is also known from the Walloon Series (Jurassic) in Queensland.[71]

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[69] Arber (17), p. 56, t. 8, fig. 5; t. 13, fig. 4.
[70] Walkom (18), p. 11.
[71] Walkom (17b), p. 25.

The present specimens are quite insufficient for full description, and it may be useful to repeat here the original description by Tenison-Woods, who had much more complete specimens. He described the species thus :—" Plant robust, thick ; stem and branches repeatedly dichotomous ; leaves thick and fleshy, densely crowded, homodromous, short, broad, obtuse, conspicuously keeled, erect, closely imbricate, but slightly spreading ; branches and branchlets very little narrower than the parent stem, and of equal width to the summit ; all portions of the plant curved, three leaves in each spiral and about three rows in one centimetre. Length of leaves, from two to three millimetres ; breadth, from five to six ; diameter of cauline stem at widest part, ten millimetres ; of branchlets, eight millimetres ; length of shortest, eighteen millimetres."[72]

Localities : Clyde Colliery (F 1208) ; Torbanlea Government Bore, $1\frac{3}{4}$ mile N.E. of Torbanlea Railway Station, at 420 feet (F 461).

Figured Specimen : Figure 12, Plate 1, is drawn from specimen F 1208 in the Queensland Geological Survey collection.

Genus ELATOCLADUS.

In his account of the earlier Mesozoic Floras of New Zealand Dr. Arber has called attention to Halle's proposed genus *Elatocladus* for " Sterile Coniferous branches of the radial or dorsi-ventral type, which do not show any characters which permit them to be included in one of the genera instituted for more peculiar forms."[73]

Dr. Arber's further remarks on this point may be quoted here as it is intended to adopt the suggestion in dealing with any further examples of such Coniferous branches. He says : " It is a common experience, when dealing with Mesozoic Conifers, to find difficulty in deciding as to which genus certain sterile shoots should be referred, the genera in question being chiefly characterized by the form of their cones. In other words, one can among these sterile shoots easily determine the species, whereas the generic attribution is a matter of greater difficulty. Dr. Halle's suggestion is that in such cases one should not attempt, in the absence of the cones, to refer the fossils to such genera as *Palissya*, *Taxites*, etc., but place them in a special genus *Elatocladus*."

This course should commend itself to anyone who has attempted the generic determination of such sterile Coniferous branches. The same difficulty has been experienced with specimens from Queensland Jurassic rocks in deciding whether to refer them to *Taxites* or

[72] Tenison-Woods (83), p. 159.
[73] Arber (17), p. 58.

Palissya. I propose therefore to follow Dr. Halle's suggestion and use the term *Elatocladus* in the sense proposed by him. This will involve only a slight change in the nomenclature for specimens already described, those referred to *Taxites planus*[74] from the Walloon Series becoming *Elatocladus planus*, and the specimens from the Maryborough Marine Series described as ? *Taxites* sp.[75] becoming *Elatocladus* sp.

The plant described as *Zamites longifolius*[76] by McCoy from Bellarine, Victoria, should probably be referred to this genus and is similar to specimens described as *E. conferta*[77] by Arber from New Zealand.

Elatocladus planus (Feistmantel).

(Plate 2, figs. 4, 5.)

1879. *Taxites planus*, Feistmantel, Foss. Fl. Gondwana Sm., 1, pt. 4, t. 13-15.

1883. ? *Taxites medius*, Tenison-Woods, Proc. Linn. Soc. N.S. Wales, 8, p. 160, t. 9, fig. 3.

1902. *Palissya gracilis*, Shirley, Qland. Geol. Surv. Bull. 18, p. 8, t. 2.

1904. *Taxites* sp. (?), Seward, Rec. Geol. Surv. Vic., vol. 1, pt. 3, p. 182.

1917. *Taxites planus*, Walkom, Qland. Geol. Surv. Pub. 259, p. 25, t. 9, fig. 4.

Specimens which are indistinguishable from those already described from the Walloon Series (Jurassic) are of common occurrence in the Burrum Series. They consist of portions of fronds with leaves generally twisted into two rows, though they are probably really spirally arranged as suggested by their irregularity in many specimens. The leaves are decurrent, linear, up to about 1·5 cm. long and to 1 mm. wide, pointed, have a single median vein, and are slightly contracted at the base.

The only other Australasian species described are *Palissya australis* McCoy and *Taxites* sp. from Victoria,[78] and *Elatocladus conferta* (Oldham and Morris) and *E.* sp. from New Zealand.[79]

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[74] Walkom (17b), p. 25.
[75] Walkom (18), p. 13.
[76] McCoy (74), p. 35, t. 8, fig. 3.
[77] Arber (17), p. 58.
[78] Seward (04a), p. 182.
[79] Arber (17), pp. 58, 59.

Palissya australis McCoy is placed as a synonym of *E. conferta* by Arber ; *Taxites* sp., described by Seward, seems most probably to belong to the present species. *E. planus* differs from *E. conferta* chiefly in its longer leaves which are pointed and not obtuse. There is also a difference in their general appearance due largely to the difference in their leaves.

It is possible that we should unite these two under a single species, but for the present as there appears to be a certain amount of distinction between them the Queensland specimens are retained as *E. planus*.

The species appears to be of more common occurrence in the Burrum Series than in the Walloon Series.

Localities : Burrum No. 1 Government Bore, Riverbank Colliery, ¾ mile S.E. of Burrum Railway Station, at 419 feet (F 1150) ; Burrum No. 2 Government Bore, Dundee Colliery, ¾ mile S.E. of Howard Railway Station, at 122 feet (F 1193) ; Howard (F 17) ; Takura No. 3 Government Bore, 2½ miles S.W. of Takura Railway Station, at 390 feet (F 52) ; Takura No. 5 Government Bore, 2½ miles S.W. of Takura Railway Station (F 763) ; Torbanlea Government Bore, 1¾ mile N.E. of Torbanlea Railway Station at 123, 860, and 880 feet (F 1194) ; ? Turner's Selection, about ¾ mile N.N.E. of Burrum Railway Station (F 1195) ; Urangan No. 5 Government Bore, Pulgil Creek, at 380 feet (F 811).

Figured Specimens : The originals of Plate 2, figs. 4 and 5, are specimens F 1193 and F 811 in the Queensland Geological Survey collection.

? Elatocladus sp.

Several specimens of similar type to species of *Elatocladus*, but of very small size, are included here. They have small, narrow leaves (up to about 5 mm. long and ·5 mm. wide) which are decurrent, and although they appear to be distichous are more probably spirally arranged. Some of them show two or three very fine striations on the surface.

The position of these specimens is uncertain and they are for the present referred doubtfully to *Elatocladus* sp. until better material is available.

Localities : Clyde Colliery (F 1206) ; Dundee Colliery, Howard (F 1207) ; Takura No. 4 Government Bore, 4 miles S.W. of Takura Railway Station, at 500 feet (F 777) ; Torbanlea Government Bore, 1¾ mile N.E. of Torbanlea Railway Station, at 800 feet (F 458).

Genus NAGEIOPSIS.

Nageiopsis zamioides (?) (Fontaine).

(Plate 1, fig. 2.)

1890. *Nageiopsis zamioides*, Fontaine, Mon. U.S. Geol. Surv., xv, p. 196, t. 79, figs. 1, 3; t. 80, figs. 1, 2, 4; t. 81, figs. 1-6.

1895. *Nageiopsis* cf. *N. heterophylla*, Seward, Wealden Flora, pt. ii, p. 211, t. 12, fig. 3.

1911. *Nageiopsis zamioides*, Berry, The Lower Cretaceous Deposits of Maryland, Maryland Geol. Surv., p. 386, t. 62, figs. 1, 2; t. 63.

(For full synonymy *see* Berry (11), p. 386.)

Fontaine proposed the genus *Nageiopsis* in 1890 and described a number of species. Several of these, however, have been considered by subsequent workers to belong to a single species and have been united under *N. zamioides*; the species so treated include *N. recurvata*, *N. decrescens*, *N. ovata*, *N. heterophylla*, and *N. microphylla*.

A few Burrum specimens show small fragments which have a decided resemblance to the smaller examples of *N. zamioides* and they are somewhat doubtfully referred to that species. They are portions of small fronds with apparently alternate pinnæ which are about 1 cm. long and a little over 1 mm. wide; they are ovate-lanceolate in shape, somewhat acutely pointed, and narrow to a short petiole; their broadest portion is much nearer the base than the apex; they are traversed by a few (about 5 or 6) fine veins which do not converge towards the apex.

Although these fragments are small, they resemble rather closely figured fronds of *Nageiopsis*, and they are quite distinct from any other Australian fossil plant with which I am acquainted. Their appearance is quite distinct from all the examples of *Podozamites* at present known to occur in Australian Mesozoic rocks.

N. zamioides occurs apparently abundantly in the Lower Cretaceous of Maryland and Virginia, and a similar specimen also has been described from the Wealden of England.

Localities: Takura No. 4 Government Bore, 4 miles S.W. of Takura Railway Station, at 161-171 feet (F 56); Torbanlea Government Bore, 1¾ mile N.E. of Torbanlea Railway Station (depth not given), (F 457, F 1272).

Figured Specimen: Figure 2, Plate 1, is drawn from specimen F 56 in the Queensland Geological Survey collection.

Genus PAGIOPHYLLUM.

Pagiophyllum Jemmetti Walkom.

1918. *Pagiophyllum Jemmetti*, Walkom, Qland, Geol. Surv. Pub. 262, p. 13, t. 2, figs. 7, 8.

A number of fragmentary specimens from Urangan probably belong to this species. They do not permit any more detailed information to be added regarding the species, which was described from the Maryborough Series as follows :—[80] "This species has a thick stem, the impression being about 5 mm. wide, with numerous closely set spirally arranged leaves. The leaves are short, thick and fleshy ; they are a little over 1 cm. long and about 5 mm. wide and are obtusely rounded. Practically no structure is preserved in the leaves ; in some cases there appear to be a few (6 or 7) veins." It is somewhat of the same type as *P. crassifolium* from the European Wealden.[81]

It is possible that the specimens referred to here may have ultimately to be identified with the specimens described as *P. peregrinum* (?) and that the differences are due to different conditions of preservation, though I think that the two are distinct. *P. Jemmetti* shows a much more open arrangement of the leaves and the leaves are also more distinct in appearance than in *P. peregrinum* (?).

Locality : Pulgil Creek, Urangan (F 23).

Pagiophyllum peregrinum (?) (Lindley and Hutton).

(Plate 4, fig. 4.)

1833. *Araucaria peregrina*, Lindley and Hutton, Fossil Flora, ii, pl. 88.

1894. *Pagiophyllum peregrinum*, Ward, 20th Ann. Rept. U.S. Geol. Surv., p. 308, t. 45.

1904. *Pagiophyllum peregrinum*, Seward, Jurassic Flora, ii, p. 48, t. 5.

(For full synonymy *see* Seward (04), p. 48.)

Seward defines this species as follows :—"Vegetative shoots monopodially branched, bearing crowded, spirally disposed, fleshy leaves. The leaves vary in shape and position ; they are usually broadly triangular, sometimes reaching a length of 5 mm., imbricate and fairly closely appressed to the stem ; in some shoots they are more open in arrangement and more distinctly falcate. The back

[80] Walkom (18), p. 13.
[81] Seward (95), p. 212, t. 16, figs. 1, 2.

of the leaves bears a broad median keel, and the lamina is frequently characterised by numerous longitudinal striations or wrinklings; the apex of the leaf may be obtuse or acuminate."

The Burrum specimens which are referred to this species resemble published figures[82] closely, and there seems no adequate reason for distinguishing them from it. The rocks in which they occur are newer than those in which *P. peregrinum* occurs usually, but this is not a grave objection in cases such as the present where the name is applied to examples of sterile fronds.

The specimen figured on Plate 4, fig. 4, is probably also an example of the same species. It differs from the other specimens in that a number of leaves have become detached from the stem and the remaining ones show a much more open arrangement than usual. The leaves themselves, however, are of just the same type as those of *Pagiophyllum*. Where leaves have become detached, the leaf-bases are exposed and are generally similar to those figured by Seward[83] from the English Jurassic as *Brachyphyllum* sp. They also suggest a resemblance to the stems figured by the same author from the Uitenhage Series in South Africa as stems of *Zamites recta*.[84]

Localities: ? Briton Shaft, ½ mile E.N.E. of Howard Railway Station (F 20); Burrum No. 2 Government Bore, Dundee Colliery, ¾ mile S.E. of Howard Railway Station, at 690 feet (F 1201); Dundee Colliery, Howard (F 16); Portion 43, Urangan (F 1199); Torbanlea Government Bore, 1¾ mile N.E. of Torbanlea Railway Station, at 1,132 feet (F 1203); Torquay Railway Cutting (F 1200).

Figured Specimen: The original of Plate 4, fig. 4, is specimen F 20 in the Queensland Geological Survey collection.

Genus SPHENOLEPIDIUM.

? Sphenolepidium sp.

(Plate 2, fig. 3.)

Specimens of narrow, branched, coniferous plant with leaves spirally arranged, narrow, pointed, and generally appressed to the stem, are similar in general appearance to species of *Sphenolepidium*. The width of the branches is not more than 1 mm., the leaves being about 2 mm. long and perhaps ·5 mm. wide at the widest part.

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[82] Seward (04), t. 5.
[83] Seward (04), p. 149, t. 12, fig. 9.
[84] Seward (03), p. 21, t. 6, figs. 8, 9, 11.

A general resemblance is shown to such figures as those of *Sphenolepis Sternbergiana* and *S. Kurriana* from the Lower Cretaceous of Virginia.[85]

There is no doubt that these few specimens belong to a conifer, but they are not sufficiently well preserved to determine generic affinities, and are therefore with some hesitation doubtfully referred to *Sphenolepidium.*

Localities : Takura No. 4 Government Bore, 4 miles S.W. of Takura Railway Station, at 700 feet (F 785) ; Torbanlea Government Bore, 1¾ mile N.E. of Torbanlea Railway Station, at 88 feet (F 14) ; ? Dayman Point, Urangan (F 766).

Figured Specimen : The original of Plate 2, fig. 3, is specimen F 14 in the Queensland Geological Survey collection.

? CONIFERALES.

Genus PODOZAMITES.

Podozamites Kidstoni, Etheridge Jr.

(Plate 4, fig. 1.)

1892. *Podozamites Kidstoni*, Etheridge Jr., Geol. Pal. Qland., p. 317.

1909. *Podozamites Kidstoni*, Chapman, Rec. Geol. Surv. Victoria, vol. iii, pt. 1, p. 110, t. 18, fig. 14.

1912. *Podozamites Kidstoni*, Seward, Mem. Geol. Surv. India (Pal. Ind.), N.S. vol. iv, Mem. 4, p. 37, t. 4, fig. 59.

" Pinnæ elongate, narrow ; pinnules of variable size and length, distant from one another, alternate, and disposed at an acute angle to the rachis ; they are either short, somewhat oblong club-shaped, broad, and very blunt at their apices, or narrower and transversely elongated, abruptly attenuated or constricted at the base to an articulation with the rachis. Veins numerous, close, apparently simple, and more or less following the outlines of the pinnules. Rachis striated and decreasing in size slowly." (*Etheridge Jr.*)

This species was first described from " Burrum, above the Bridge Seam " by Etheridge, and the only fossil with which he compared it was *Zamites Meneghini* Zigno from the Italian Oolitic rocks.

The veins are numerous, about 12 in a space of 5 mm. ; they converge towards the base and also to a slight extent towards the

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[85] Berry (11), t. 74, 75.

apex. The leaves narrow to a short narrow petiole by which they are attached to the rachis. The species is quite distinct from any other Australian form.

Seward has recorded the occurrence of this species in Jurassic strata in Afghanistan.[86]

Localities: Burrum, above the Bridge Seam (F 40) (Type figured by Etheridge); Takura No. 4 Government Bore, 4 miles S.W. of Takura Railway Station, at 161-171 feet (F 62); Torbanlea Government Bore, 1¾ mile N.E. ot Torbanlea Railway Station, at 124, 377, and 1,184 feet (F 454), and at 862 feet (? F 464); Urangan No. 5 Government Bore, Pulgil Creek, at 380 feet (? F 813).

Figured Specimen: The original of Plate 4, fig. 1, is specimen F 40 in the Queensland Geological Survey collection.

Podozamites lanceolatus (Lindley and Hutton).

(Plate 4, fig. 2.)

1836. *Zamia lanceolata*, Lindley and Hutton, Fossil Flora, pl. 194.
1874. *Zamites* (*Podozamites*) *ellipticus*, McCoy, Prodromus, Pal. Vict., Decade 1, p. 35, t. 8, fig. 4.

(For full synonymy of *P. lanceolatus see* Seward (00), p. 242.)

Frond pinnate, elongate, more than 13 cm. long; pinnæ lanceolate, alternate or sub-opposite, contracted at base, up to about 3·5 cm. long and 6 mm. wide.

In 1874 McCoy described *P. ellipticus* from Bellarine, Victoria, and it has been recorded from a few further localities by Chapman[87] without additional description.

Some of the specimens from the Burrum Series agree quite well with McCoy's description and figure of *P. ellipticus*, though perhaps they are a little larger. They also agree in another feature; McCoy says in his description, "Substance thick, usually showing only 3 obtuse ridges, but sometimes 11 smaller, the whole covered with a very fine longitudinal striation." Some of the Queensland specimens show only the coarse ridges, not being sufficiently well preserved to show the finer striation. Others show very numerous fine veins with traces of a few coarser ridges. I suspect that the coarser ridges are wrinkles that have been produced during the fossilisation of the thick leaves, and that the fine longitudinal striation is the real venation.

Specimens from Dayman Point, Urangan, are imperfectly preserved in a rather coarse sediment and no trace of fine venation

[86] Seward (12), p. 37.
[87] Chapman (09).

is shown. They have about 8 parallel ridges. Others from Takura No. 4 bore show a few ridges of similar nature and in addition a number of very fine veins (about 3 or 4 per mm.). It is possible that the specimens from these two localities may not belong to the same species, but we will have to know more of the venation of the Dayman Point examples before this can be definitely settled.

McCoy's *P. ellipticus* as well as the Burrum specimens cannot be distinctly separated from *P. lanceolatus*, for which we must adopt a broad definition.

The irregular arrangement of the pinnæ on the rock surface in the specimens from Dayman Point may point to a spiral arrangement of the pinnæ rather than a lateral one.

A general definition of *P. lanceolatus* is as follows :—" Frond pinnate ; rachis slender, giving off at unequal intervals linear lanceolate segments ; the segments are characterized by their gradually tapering acuminate apices and constricted bases ; they are traversed by several parallel veins."[88]

Localities : Dayman Point, Urangan (F 770) ; Takura No. 4 Government Bore, 4 miles W. of Takura Railway Station, at 161-171 feet (F 61) ; Turner's Selection (F 5).

Figured Specimen : The original of Plate 4, fig. 2, is specimen F 770 in the Queensland Geological Survey collection.

Podozamites sp.

(Plate 4, fig. 3.)

Under this name are figured isolated leaves which are found at several localities in the Burrum Series. They consist of rather acutely pointed lanceolate pinnæ, up to 7 cm. long and 1·3 cm. broad at the widest part ; they are traversed by about 10 parallel veins. Smaller leaves of the same type are from the Takura No. 4 Bore.

These leaves are similar to those which have been referred to *Podozamites* and it is possible that some of them actually belong to the species *P. lanceolatus* described above.

Localities : Briton Shaft, ½ mile E.N.E. of Howard Railway Station (F 28) ; Takura No. 4 Government Bore, 4 miles W. of Takura Railway Station, at 550 feet (F 799) and at 600 feet (F 782) ; Torquay (F 12).

Figured Specimen : The original of Plate 4, fig. 3, is specimen F 28 in the Queensland Geological Survey collection.

88 Seward (00), p. 243.

PLANTÆ INCERTÆ SEDIS.

? Equisetaceous Sheath.

(Plate 3, fig. 8.)

The specimen figured on Plate 3, fig. 8, possibly represents an equisetaceous leaf-sheath. It shows about 12 short, somewhat wedge-shaped leaves, 4-5 mm. long, arranged in a whorl. No details of structure are preserved.

Locality: Takura No. 5 Government Bore, 2½ miles S.W. of Takura Railway Station (F 761).

Figured Specimen: The original of Plate 3, fig. 8, is specimen F 761 in the Queensland Geological Survey collection.

Obscure Cones ?

(Plate 1, figs. 6, 7.)

Fragmentary remains of two types of cone are figured on Plate 1. It is not possible to attempt any determination of them but they serve to indicate the occurrence of gymnospermous cones in these rocks. In one of them (F 1209) there appears to be a stout axis from which a number of slender stalks are given off at right angles, and at the end of each there is a small scale or seed. The other is a much more compact form, in which, however, details cannot be distinguished.

Localities: Pulgil Creek, Urangan (F 1256, F 1209); Torbanlea Government Bore, 1¾ mile N.E. of Torbanlea Railway Station, at 878 feet (F 465).

Figured Specimens: Figures 6 and 7, Plate 1, are drawn from specimens F 1209 and F 465 in the Queensland Geological Survey collection.

? Roots.

(Plate 2, fig. 2.)

A specimen showing a series of irregularly branching structures about 1 mm. wide may represent roots. These structures are in general appearance very similar to those already described from the Marine Cretaceous rocks of Maryborough.[89] They show no detail of structure whatever.

Locality: Torbanlea Government Bore, 1¾ mile N.E. of Torbanlea Railway Station at 425 feet (F 1145).

Figured Specimen: The original of Plate 2, fig. 2, is specimen F 1145 in the Queensland Geological Survey collection.

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[89] Walkom (18), p. 14.

THE FLORA OF THE STYX SERIES.

By A. B. Walkom, D.Sc.

The number of species known in the Styx Series is not at present very great, but as a whole the flora is one of considerable interest, the most important feature being the presence of a number of dicotyledonous leaves. These are the earliest representatives of the Angiosperms yet recorded in Australia, and in view of their occurrence the greatest age which can be assigned to the Series is Lower Cretaceous.

The association of dicotyledonous leaves with a number of typical Mesozoic plants leaves no doubt that the age of the strata is Cretaceous, probably Lower Cretaceous. The assemblage of plants seems to show clearly that the Styx Series is somewhat younger than the Burrum Series ; the fact that among some hundreds of specimens from the latter there are no dicotyledonous leaves, whilst among comparatively few specimens from the former such leaves are numerous, is sufficient indication of this difference in age.

Amongst Lower Cretaceous floras, that of the Styx Series shows considerable resemblances to the Patapsco Flora of Maryland and Virginia and the Waikato Heads Flora of New Zealand. The Patapsco Flora occurs in the upper part of the Potomac Formation ; it contains over eighty species and has been referred by Berry to the Albian Stage of the Lower Cretaceous.[90] The plants occurring at Waikato Heads have been referred by Arber[91] to the Neocomian Stage of the Lower Cretaceous, but as only eight species were described the evidence is perhaps insufficient to correctly determine the stage of the Lower Cretaceous to which the strata should be referred, and it may be better, for the present, simply to regard them as Lower Cretaceous. The plants known from Waikato Heads are : *Cladophlebis australis*, *C. Albertsi* ?, *C.* sp., *Microphyllopteris pectinata*, *Tæniopteris arctica*, *Nageiopsis longifolia* ?, *Artocarpidium Arberi*, and *Phyllites* sp. A comparison of this list with the Styx plants at once shows the close relation to the two floras.

The species described from the Styx Series are :

Equisetites sp.,
Cladophlebis australis (Morris),
Nathorstia (?) *Willcoxi*, n. sp.,
Phyllopteris lanceolata, Walkom,

[90] Berry (11).
[91] Arber (17), p. 17.

(?) *Microphyllopteris gleichenioides*, O. and M.,
Otozamites cf. *queenslandi*, Walkom,
Tæniopteris spatulata, McClelland,
Tæniopteris howardensis, Walkom,
Araucarites sp.,
(?) *Sphenolepidium* sp.,
Podozamites sp.,
(?) *Celastrophyllum* cf. *Hunteri*, Ward,
(?) *Celastrophyllum* sp.,
Phyllites sp.

These fall into the larger plant groups as follows :—

	No. of Species.
Equisetales	1
Filicales	4
Cycadophyta	3
Coniferales	3
Dicotyledones	3
Total	14

It must be concluded that the Styx Series is somewhat younger and represents a higher stage of the Lower Cretaceous than the Burrum Series. The latter has been determined as representing the lower stages (Neocomian-Barremian) of the Lower Cretaceous, and although the number of species is rather limited it is suggested that the Styx Series may be the equivalent of the Albian Stage.

DESCRIPTION OF THE SPECIMENS.

EQUISETALES.

Equisetites sp.

In describing the flora of the Ipswich and Walloon Series, a specimen from the Styx River was dealt with in error and referred to *Equisetites* sp.[92] The following remarks are those already published referring to this specimen : "A number of flattened stems occur on a specimen (F 472) from the Styx River. They exhibit a series of well-defined ribs, there being about 10 on the flattened surface, so that the total number must have been about twenty. These are opposite and not alternate on adjacent internodes. The width of the impressions is up to 9 mm. and the internodes attain

[92] Walkom (15), p. 31, t. 3, fig. 2.

a length of more than 8 cm. The distinctive character of the specimen is the great length of the internodes compared with the breadth. While not agreeing closely with any particular species, a resemblance in general appearance may be noted with smaller stems of *E. mougeoti* (Brong.) as figured by Schimper.[93]

Locality : Styx River (F 472).

FILICALES.

? *OSMUNDACEÆ.*

Cladophlebis australis (Morris).

(*See above*, p. 13.)

A few specimens of the typical form of *Cladophlebis australis* (Morris) have been obtained from the Styx River Coal Measures. They are practically identical with specimens found in the Burrum Series, which have already been described (*see above*, p. 13).

Localities: Styx No. 2 Bore, at 596 feet (F 1075) and 600 feet (F 1080) ; Styx No. 4 Bore, at 163 feet (F 1246) and at 228 feet (F 1255).

? *MARATTIALES.*

Nathorstia (?) Willcoxi, n. sp.

(Plate 7, figs. 5, 6.)

Leaf linear, parallel-sided, about 1 cm. broad, length ? ; midrib prominent, striated longitudinally, about 1 mm. wide ; secondary veins simple, slightly arched, practically at right angles to the midrib, relatively widely spaced (15 in space of 2 cm.). In well-preserved specimens there is a very fine network between the secondary veins.

Fertile specimens show the sori arranged in two rows, parallel and close to the midrib, one on either side of it. The sori are between the secondary veins ; they are roughly circular, about 1 mm. in diameter and are made up of a number of sporangia, of which no details are preserved in the specimens obtained up to the present.

In the absence of detail as regards the sporangia, the correct generic determination of this species is practically impossible. Heer

[93] *See* Schimper (74), Pl. xii, fig. 3.

has used the name *Nathorstia* for specimens from the Lower Cretaceous of Greenland, but his original description is not available to the author. Seward,[94] however, has mentioned Heer's genus and reproduced two of his figures. The present specimens agree with Heer's *N. angustifolia* in general shape, in the general appearance and arrangement of the sori, and in the nature of the secondary veins. They are somewhat larger than *N. angustifolia* and in that species there is no mention of a fine network between the simple secondary veins.

Seward[95] remarks on the great difficulty in distinguishing between *Nathorstia* and *Laccopteris* in the absence of detail of the sporangia, and since there is an anastomosing venation in *Laccopteris* we might be justified in surmising that there is also in *Nathorstia*.

In the Styx River specimens the secondary veins are all simple, as are also the few shown in Heer's figure[96] of the Greenland species, and if this is a constant character it would prevent confusion of these two species with *Laccopteris*.

It is therefore thought that the reference of these specimens to the genus *Nathorstia* is a reasonable one in view of our present knowledge of it. At the same time it is noted that the specimens show considerable similarity in general appearance to some recent species of *Polypodium* occurring in the Queensland flora,[97] and this raises the possibility of their belonging not to the Marattiales but to the Polypodiaceæ.

It is hoped that more perfect specimens of this species will be obtained in the near future.

The species is named in honour of Mr. W. T. Willcox of the Queensland Geological Survey, who made the preliminary field examination of the Styx River coal outcrops and who collected most of the material herein described.

Localities: Styx No. 1 Bore, at 634 feet (F 1233); Styx No. 2 Bore, at 564 feet (F 1077); Styx No. 3 Bore, at 397 feet (F 1093).

Figured Specimen: The original of Plate 7, fig. 5, is specimen F 1233 in the Queensland Geological Survey collection.

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[94] Seward (10), p. 410, fig. 294 A, B.

[95] Seward (10), p. 410.

[96] *See* Seward (10), fig. 294B.

[97] Bailey (92), pp. 157-163.

FILICALES INCERTÆ SEDIS.

PHYLLOPTERIS LANCEOLATA (Walkom).

(*See above*, p. 22.)

Fragmentary examples of this species are of comparatively common occurrence in the Styx Series. They do not differ in any respect from those occurring in the Burrum Series, described above (p. 22).

Localities : Deep Creek (F 1254) ; Styx No. 2 Bore, at 600 feet (F 1079) ; ? Styx No. 4 Bore, at 166 feet (F 1251).

?MICROPHYLLOPTERIS GLEICHENIOIDES (O. and M.).

(*See above*, p. 26.)

A small fragment of a single pinna appears to belong to this species. It has a number of short, bluntly rounded pinnules, about 1 mm. wide and a little more than 1 mm. long, attached to the rachis by their whole base ; no venation is visible.

Similar specimens are of common occurrence in the Burrum Series.

Locality : Styx No. 3 Bore, at 312 feet (F 1099).

CYCADOPHYTA INCERTÆ SEDIS.

OTOZAMITES cf. QUEENSLANDI (Walkom).

(Plate 7, fig. 1.)

1917. *Otozamites queenslandi*, Walkom, Qland. Geol. Surv. Pub. 259, p. 21, pl. 7, figs. 3-5.

A specimen showing the apical portion of a cycadean frond is referred to here. The pinnæ make an angle of about 45° with the rachis ; they are alternate, obtusely rounded, a little over 1 cm. in length and 2 to 3 mm. in breadth, attached to the upper surface of the rachis and slightly auriculate at the base. The veins are slightly divergent and branch infrequently, there being about 7 at the base and about 12 at the apex of a pinna.

This specimen resembles the apical portion of specimens which have been described as *Otozamites queenslandi* from the Walloon Series[98] and may be identical with that species.

Locality : Styx No. 4 Bore, at 163 feet (F 1250).

Figured Specimen : The original of Plate 7, fig. 1, is specimen F 1250 in the Queensland Geological Survey collection.

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[98] Walkom (17b), p. 21.

? CYCADOPHYTA.

Tæniopteris spatulata (McClelland)

(*See above*, p. 36.)

Several specimens cannot well be separated from this common Jurassic and Cretaceous type. They have a leaf about 1·3 cm. wide, with a prominent midrib 1 mm. wide; secondary veins are at right angles to the midrib and there are about 12 of them in 4 mm.

Localities: Styx No. 4 Bore, at 226 feet 6 inches (F 1243); Styx River Coal Shaft on Tooloombah Creek, C.P.A. 62, about 3¼ miles S.W. of 80-mile railway peg (F 834).

Tæniopteris howardensis (Walkom).

1918. *Tæniopteris howardensis*, Walkom (*see above*, p 36.).

A few specimens referable to this species have been found in the Styx River Series. Leaves ·8 to 1·4 cm. wide; midrib prominent, striated longitudinally, 1 mm. broad; secondary veins at wide angle to midrib, fine, divide once or twice, close together (17 in 3 mm.).

Localities: Deep Creek (F 1240); Styx River Coal Shaft, St. Lawrence (F 27).

CONIFERALES.

Araucarites sp.

Amongst the collection is a single Araucarian cone-scale, which is broadly wedge-shaped, about 2 cm. long and 1·3 cm. wide at the widest part.

This is of the same general appearance as those described from the Burrum Series as *A. Arberi*,[99] but there is no preservation in this case of an apical spine, though the broken edge suggests that such a spine may have been present.

Locality: Foyle Park, Wilangi (F 46).

? Sphenolepidium sp.

Small fragments of coniferous branches may be provisionally referred to *Sphenolepidium*. They have small, narrow, acutely pointed leaves, spirally arranged and resembling in general appearance typical examples of this genus.

Localities: Styx No. 1 Bore, at 214 feet (F 1248); Styx No. 2 Bore, at 600 feet (F 1078).

[99] *See* above, p. 40.

? CONIFERALES.

PODOZAMITES sp.

A number of specimens show portions of pinnæ of somewhat doubtful affinities. In general they are up to about 1 cm. in width, but their length is indeterminable; they are somewhat acutely pointed and are traversed by a number of parallel veins.

In the absence of any complete specimen it is not possible to determine them with certainty. Probably most of them belong to *Podozamites*, but it is quite possible that some may be fragments of such species as *Zamites takuraensis* (*see above*, p. 31).

Localities: Styx No. 3 Bore at 400 feet 6 inches (F 1098); Styx No. 4 Bore, at 163 feet (F 1247); Styx River Coalfield (F 45).

ANGIOSPERMÆ.

DICOTYLEDONES.

Amongst the specimens obtained from the Styx River bores there are a number of examples of dicotyledonous leaves, and in these lies the especial interest of the Styx River flora. These dicotyledonous leaves are associated with plants which are of very common occurrence in the Burrum Series. There are at least three distinct types, but on account of the great difficulty of determining dicotyledons from mere fragmentary leaves it is not possible to deal with them at all satisfactorily. Two of them I showed to Mr. C. T. White, Government Botanist, and he told me that both were very common types of leaf amongst dicotyledons.

? CELASTROPHYLLUM cf. HUNTERI Ward.

(Plate 7, fig. 2.)

1896. *Celastrophyllum Hunteri*, Ward, 15th Ann. Rept. U.S. Geol. Surv., p. 358, pl. 4, fig. 9.

1911. *Celastrophyllum Hunteri*, Berry, Maryland Geol. Surv., Lower Cretaceous, p. 480, pl. 90, figs. 5, 10, 11.

The specimen referred to here has a lamina about 8 cm. long and 2 cm. wide at widest part; it tapers gradually at about the same rate towards each end. The margin is serrate, and the venation very poorly preserved.

It is practically impossible to refer this with certainty to any genus or species, but it shows a general resemblance to *C. Hunteri*

from Virginia, figured by Berry[100] and may for convenience in reference be compared with that species. Mr. White pointed out to me that there was also a close resemblance in general shape to some species of *Cupania*.

Localities : Styx No. 3 Bore, at 503 feet (F 1095) ; Styx No. 4 Bore, at 163 feet (F 1236).

Figured Specimen : The original of Plate 7, fig. 2, is specimen F 1095 in the Queensland Geological Survey collection.

? Celastrophyllum sp.

(Plate 7, fig. 4.)

Leaf long, pointed ; probably about 7 cm. long and 1·1 cm. wide at the widest part ; margin toothed with teeth about 1 cm. apart. Secondary veins alternate, branching at an angle of about 30° from the midvein, and connected at their outer ends by veins roughly parallel to the margin of the leaf. Network formed by the tertiary veins fine and somewhat indistinct.

These specimens also resemble in general certain species described as *Celastrophyllum* from the Lower Cretaceous of North America and may provisionally be referred to that genus.

Localities : Styx No. 1 Bore, at 525 feet (F 1073), and at 634 feet (F 1241) ; Styx No. 2 Bore, at 597 feet (F 1076) ; Styx No. 3 Bore, at 312 feet (F 1082) ; Styx No. 4 Bore, at 226 feet 6 inches (F 1234).

Figured Specimen : The original of Plate 7, fig. 4, is specimen F 1073 in the Queensland Geological Survey collection.

Phyllites sp.

(Plate 7, fig. 3.)

Portion of a leaf of very different type to those already referred to *Celastrophyllum* may be described as *Phyllites* sp. The leaf is apparently somewhat circular in outline, with entire margin. The venation is only indistinctly preserved. The specimen is figured but it is not possible to institute any reliable comparisons.

Locality : Styx No. 3 Bore, at 316 feet (F 1085).

Figured Specimen : The original of Plate 7, fig. 3, is specimen F 1085 in the Queensland Geological Survey collection.

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[100] Berry (11), Pl. 90, fig. 11.

PLANTA INCERTÆ SEDIS.

(Plate 7, fig. 7.)

Some specimens from the Styx No. 4 Bore are unlike anything figured in the literature available to me, and they are figured here in the hope that the figures may afford some clue to the affinities of the specimens.

They apparently represent stems which have been flattened; they taper gradually and the greatest breadth of the impressions preserved is about 6 mm.; the stems show a number of distinct longitudinal striations, and along each side of the impression there is a fringe of short thin appendages, about 2 mm. in length. Whether these appendages were present over the whole stem cannot be observed, but it is probable that they were. There is a faint resemblance to the stem of such a form as *Lycopodium squarrosum* as figured by Seward,[101] and this suggests the possibility that the specimens may belong to the Lycopodiales.

Locality: Styx No. 4 Bore, at 163-165 feet (F 1238).

Figured Specimen: The original of Plate 7, fig. 7, is specimen F 1242 in the Queensland Geological Survey collection.

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[101] Seward (10), fig. 122.

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EXPLANATION OF PLATES.

Unless otherwise stated, figures are reproduced natural size.

PLATE 1.

1. *Tæniopteris howardensis*, Walkom. Riverbank Colliery, Burrum. *See* p. 36.
2. *Nageiopsis zamioides* (?), Fontaine. Takura No. 4 Government Bore, at 161-171 feet. *See* p. 45.
3. *Ginkgo digitata* (Brongniart). Dudley Colliery, Burrum. *See* p. 38.
4. *Ginkgo digitata* (Brongniart). Dudley Colliery, Burrum. *See* p. 38.
5. *Sphenopteris burrumensis*, Walkom. Burrum No. 2 Government Bore, at 600-700 feet. *See* p. 19.
6. Osbcure cone ? Pulgil Creek, Urangan. *See* p. 51.
7. Obscure cone ? Torbanlea Government Bore, at 878 feet. *See* p. 51.
8. *Microphyllopteris acuta*, Walkom. Burrum No. 4 Government Bore, at 122 feet. *See* p. 27.
9. *Tæniopteris spatulata*, McClelland. Argyle Creek No. 2 Bore. *See* p. 36.
10. *Stenopteris elongata*, Carruthers. Argyle Creek No. 2 Bore. *See* p. 28.
11. *? Chiropteris* sp. ($\times\frac{4}{3}$). Burrum No. 1 Government Bore, at 419 feet. *See* p. 20.
12. *Brachyphyllum crassum*, Tenison-Woods. Clyde Colliery. *See* p. 41.
13. *? Dictyophyllum* sp. ($\times\frac{4}{3}$). Urangan No. 3 Government Bore, at 780 feet. *See* p. 15.
14. *Nilssonia schaumburgensis* (?) Dunker. ($\times\frac{4}{3}$.) Burrum No. 1 Government Bore. *See* p. 33.
15. *Nilssonia schaumburgensis* (?), Dunker. ($\times\frac{4}{3}$.) Burrum No. 1 Government Bore. *See* p. 33.
16. *Araucarites* (?) *polycarpa*, Tenison-Woods. Urangan Point, Pialba. *See* p. 39.

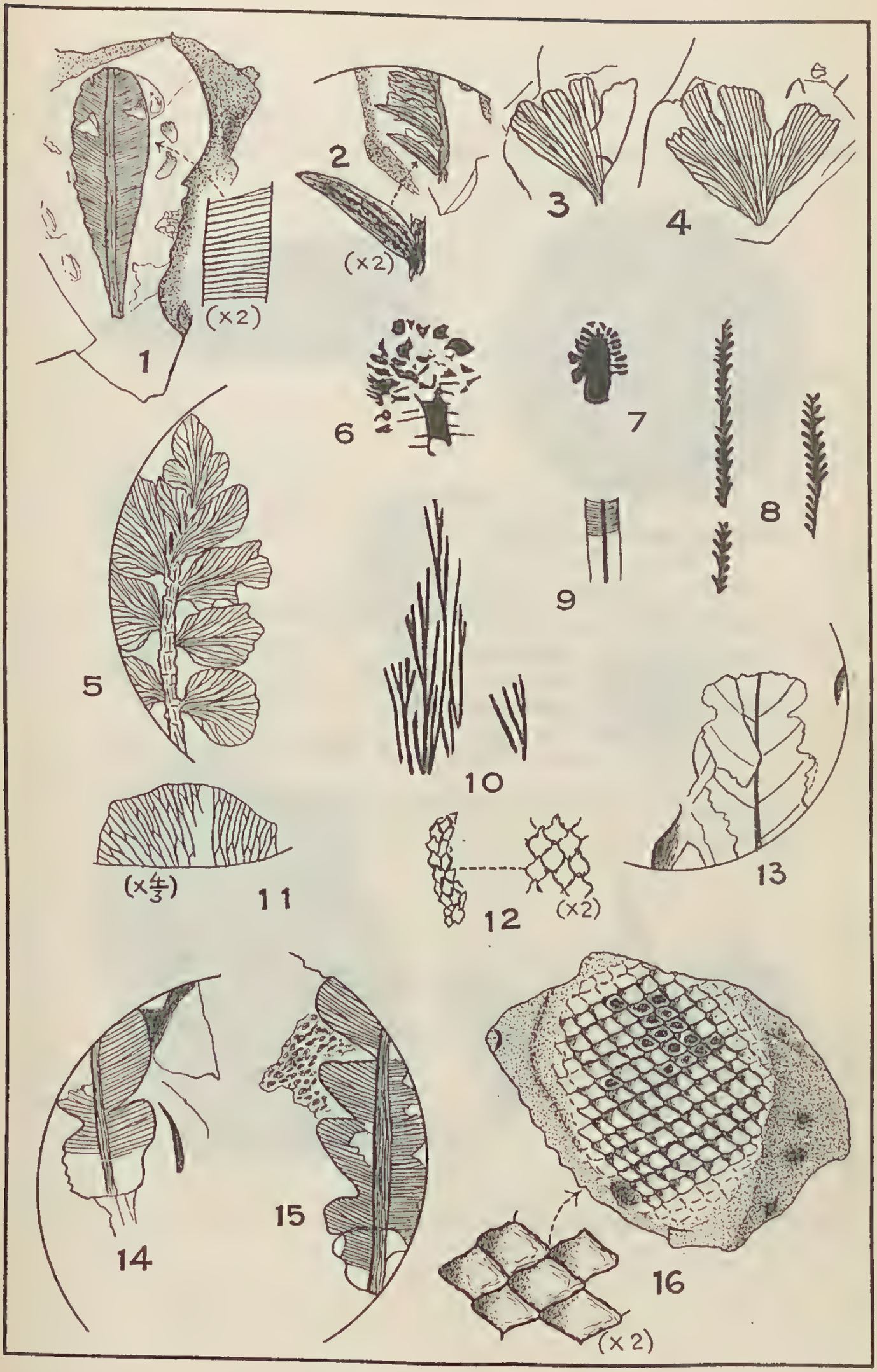
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PLATE 2.

1. *Zamites takuraensis*, Walkom. Takura No. 4 Government Bore, at 40 feet. *See* p. 31.
2. ? Roots. Torbanlea Government Bore. *See* p. 51.
3. *? Sphenolepidium* sp. Torbanlea Government Bore, at 88 feet *See* p. 47.
4. *Elatocladus planus* (Feistmantel). Burrum No. 2 Government Bore, at 122 feet. *See* p. 43.
5. *Elatocladus planus* (Feistmantel). Urangan No. 5 Government Bore, at 380 feet. *See* p. 43.
6. *Microphyllopteris gleichenoides*, O. and M. Dundee Colliery, Howard. *See* p. 26.
7. *Araucarites Arberi*, Walkom. Torquay Railway Cutting. *See* p. 40.
8. *Araucarites Arberi*, Walkom. Portion 43, Parish Urangan. *See* p. 40.

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PLATE 3.

1. *Phyllopteris lanceolata*, Walkom. Turner's Selection, Burrum. *See* p. 22.
2. *Phyllopteris lanceolata*, Walkom. Turner's Selection, Burrum. *See* p. 22.
3. *Phyllopteris lanceolata*, Walkom. Portion of fig. 2 showing venation.
4. *Ptilophyllum* (*Williamsonia*) *pecten* (Phillips). Torbanlea Government Bore, at 909 feet. *See* p. 30.
5. *Stenopteris laxum* (Tenison-Woods). Briton Shaft, Howard. *See* p. 29.
6. *Cladophlebis australis* (Morris). Takura No. 4 Government Bore, at 600 feet. *See* p. 13.
7. *Cladophlebis australis* (Morris). Burrum, above the Bridge Seam *See* p. 13.
8. ? Equisetaceous sheath. Takura No. 5 Government Bore. *See* p. 51.
9. *Sphenopteris flabellifolia*, Tenison-Woods. Burrum No. 3 Government Bore. *See* p. 16.
10. *Sphenopteris flabellifolia*, Tenison-Woods. Pinnule of fig. 9 showing venation.

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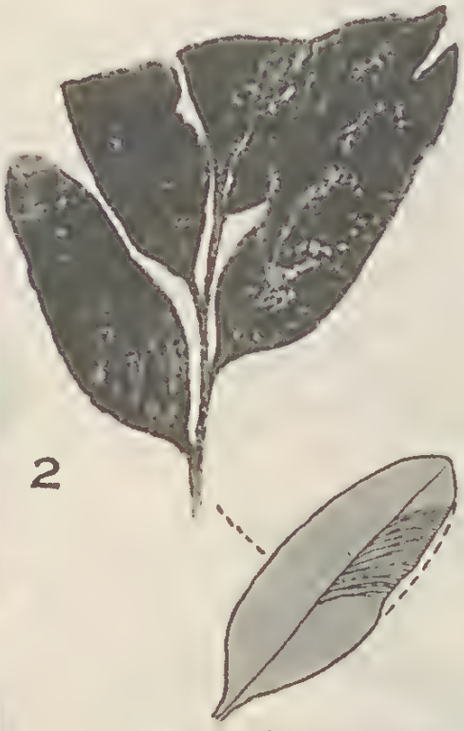

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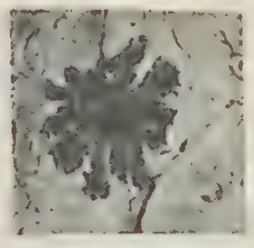

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PLATE 4.

1. *Podozamites Kidstoni*, Etheridge Jr. Burrum, above the Bridge Seam. *See* p. 48.
2. *Podozamites lanceolatus*, L. and H Dayman Point, Urangan. *See* p. 49.
3. *Podozamites* sp. Briton Shaft, Howard. *See* p. 50.
4. *Pagiophyllum peregrinum* (?), L. and H. ? Briton Shaft, Howard. *See* p. 46.

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PLATE 5.

1. *Phyllopteris expansa*, Walkom. Dayman Point, Urangan. *See* p. 24.
2. *Phyllopteris expansa*, Walkom. Portion of fig. 1 showing venation.
3. *? Neocalamites* sp. Briton Shaft, Howard. *See* p. 13.
4. *Sphenopteris erecta* (Tenison-Woods). Briton Shaft, Howard. *See* p. 18.
5. *Sphenopteris erecta* (Tenison-Woods) Portion of fig. 4 showing venation.

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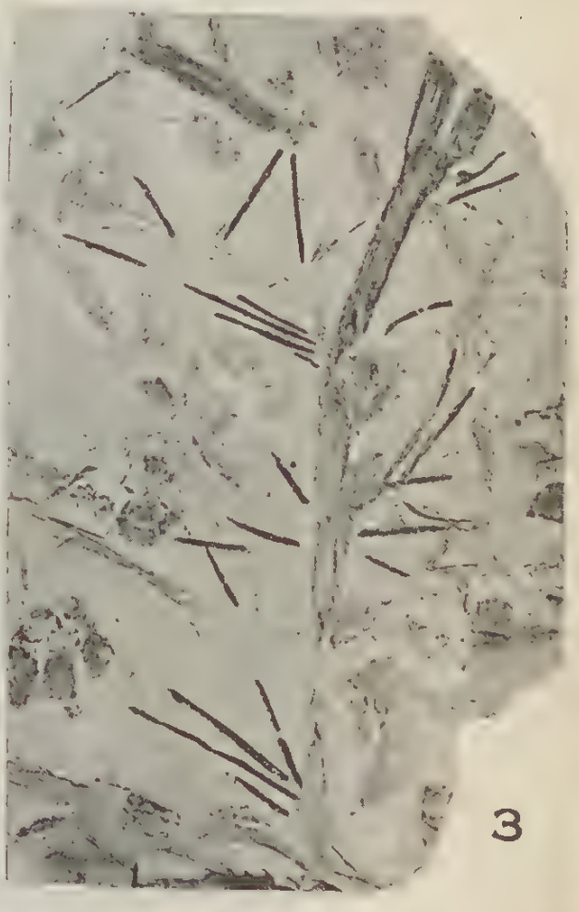

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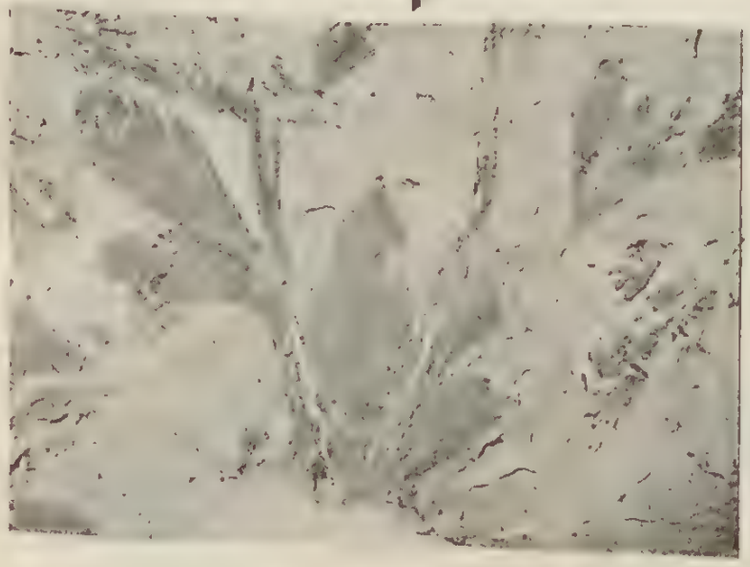


4

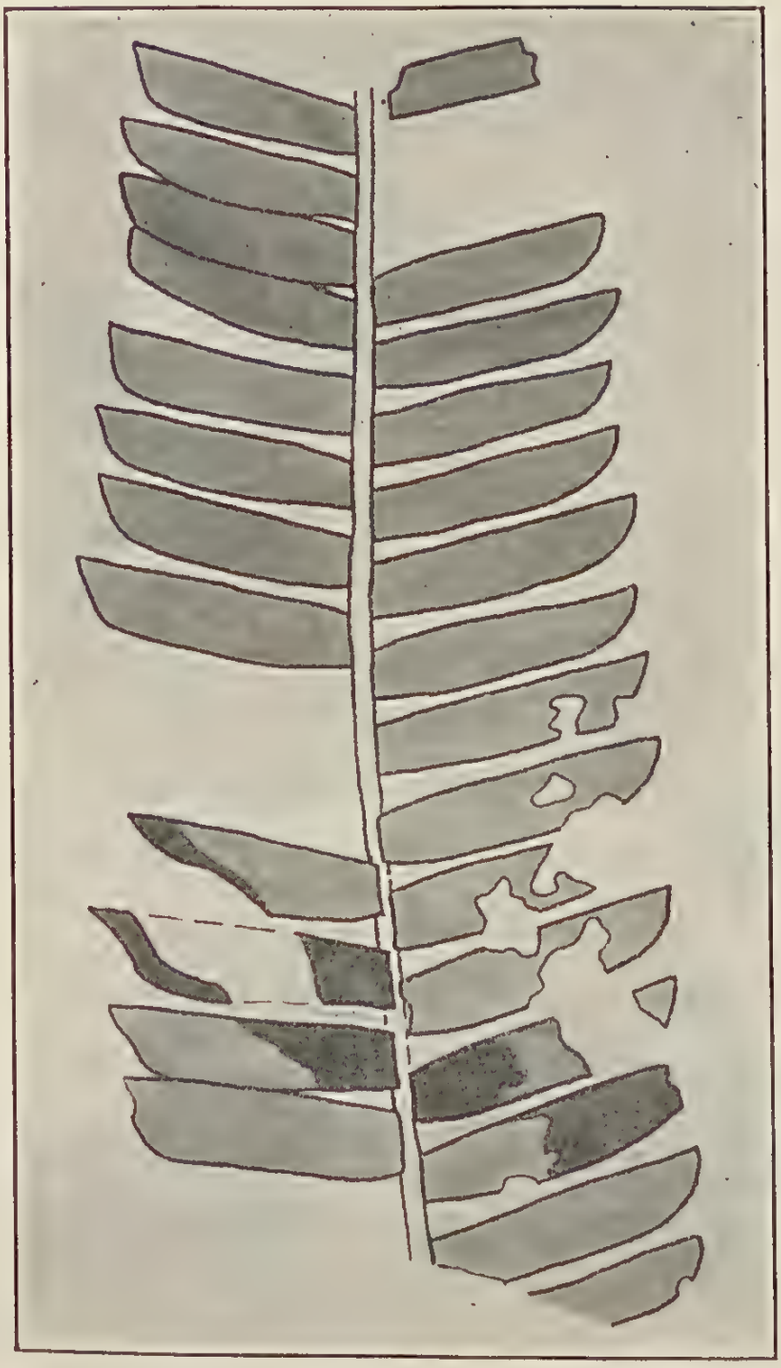
PLATE 6.

1. *Nilssonia mucronatum* (De Vis). Wyangarie Station, Q. *See* p. 34.

2. *Nilssonia mucronatum* (De Vis). Portion of fig. 1 showing attachment of pinnæ to rachis.

3. *Nilssonia mucronatum* (De Vis). Two fragments showing venation.

(Blocks for Plate 6 kindly lent by the Director of the Queensland Museum.)



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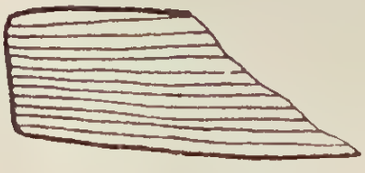
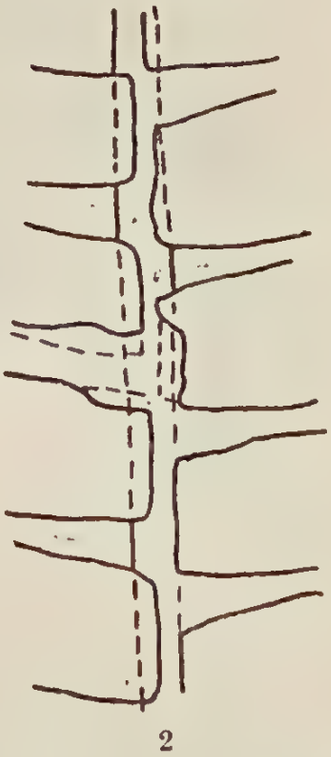


3*a*

3*b*

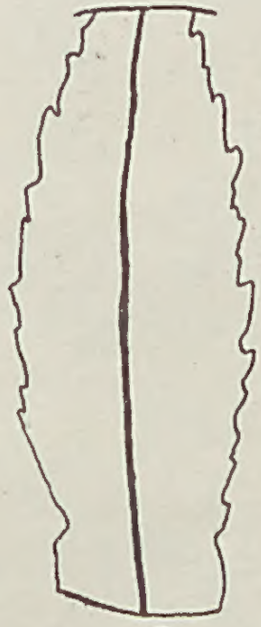


2

PLATE 7.

1. *Otozamites* cf. *queenslandi*, Walkom. Styx No. 4 Bore, at 163 feet. *See* p. 56.
2. *? Celastrophyllum* cf. *Hunteri*, Ward. Styx No. 3 Bore, at 503 feet. *See* p. 58.
3. *Phyllites* sp. Styx No. 3 Bore, at 316 feet. *See* p. 59.
4. *? Celastrophyllum* sp. Styx No. 1 Bore, at 525 feet. *See* p. 59.
5. *Nathorstia* (?) *Willcoxi*, Walkom. Styx No. 1 Bore, at 634 feet. *See* p. 54.
6. *Nathorstia* (?) *Willcoxi*, Walkom. Enlargement of portion of fig. 5 showing single sorus. (×15). *See* p. 54.
7. Planta incertæ sedis. Styx No. 4 Bore, at 163-165 feet. *See* p. 60.

1



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3

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